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WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY. VOLUME III. --ETC(U)

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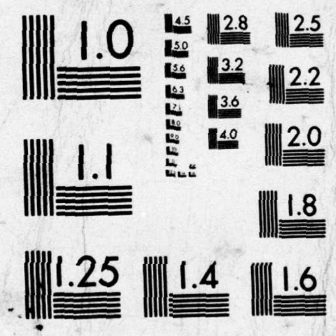


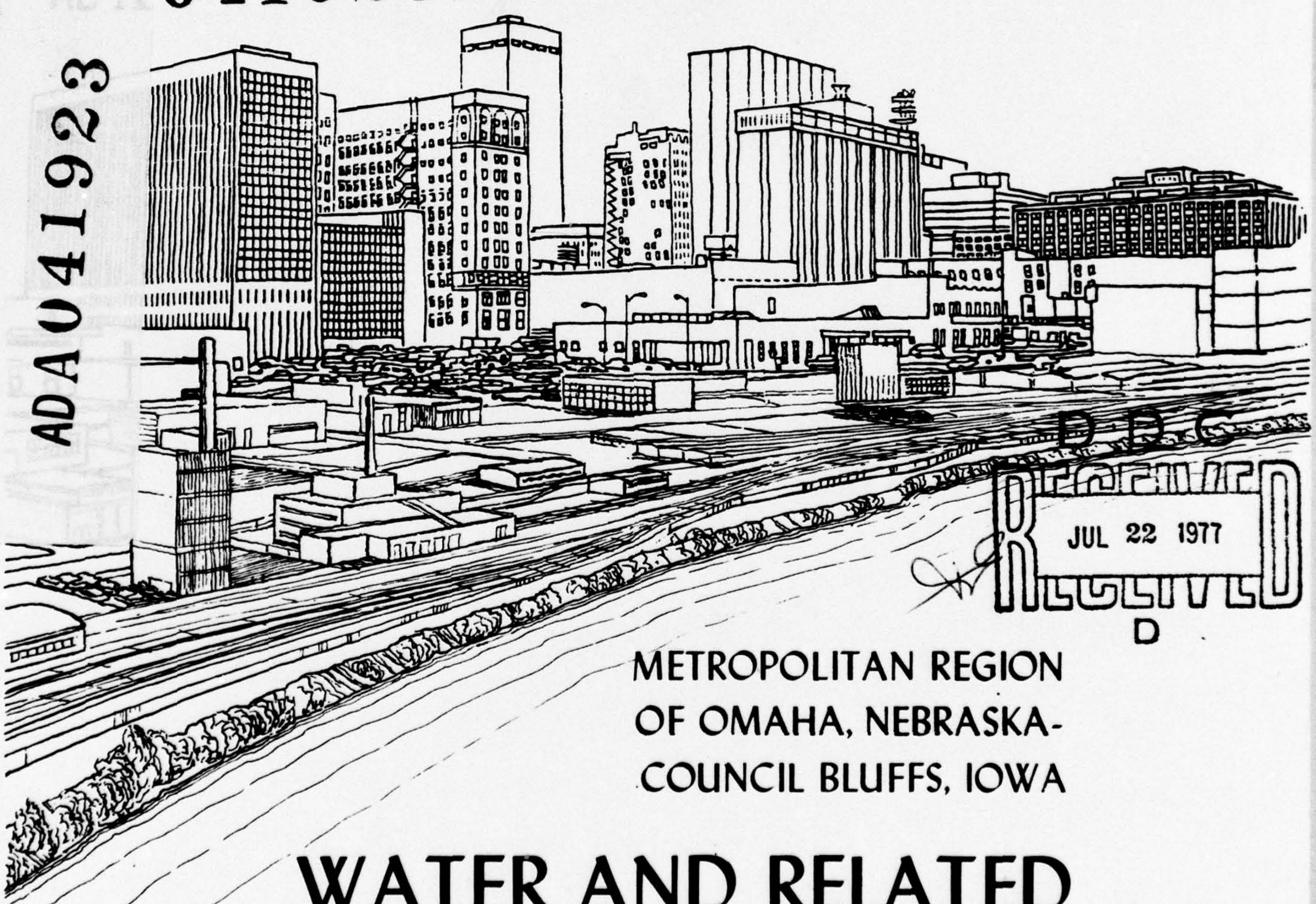
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

VOLUME III

PLAN FORMULATION APPENDIX

ANNEX B - WASTEWATER MANAGEMENT

REVIEW REPORT ON THE MISSOURI RIVER AND TRIBUTARIES



METROPOLITAN REGION
OF OMAHA, NEBRASKA-
COUNCIL BLUFFS, IOWA

WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY

ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

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JUNE 1975

REVIEW REPORT FOR

Metropolitan

Omaha, Nebraska-

Council Bluffs, Iowa

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WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY.

Volume III. Plan Formulation Appendix.
Annex B. Wastewater Management.

ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

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REVIEW REPORT FOR METROPOLITAN OMAHA, NEBRASKA COUNCIL BLUFFS, IOWA WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY

Volume III Plan Formulation Appendix

PREPARED BY THE

OMAHA DISTRICT CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

REVIEW REPORT FOR
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
WATER AND RELATED LAND
RESOURCES MANAGEMENT STUDY

Plan Formulation Appendix

Annex B — Wastewater

PREPARED BY THE

OMAHA DISTRICT, CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

SECTION A

INTRODUCTION

INTRODUCTION

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SECTION A

INTRODUCTION

Purpose and Scope

1. The purpose of the overall Urban Study is to aid in developing water resources and related land areas to enhance the quality of urban life. To do this, single-purpose studies are being undertaken dealing with various water sources and uses; wastewater, water supply, water recreation, and flood control. These single-purpose studies will then be linked to aid in developing a water resource management program for the urban region. This study involves the wastewater management portion of the Urban Study for the seven-county metropolitan Omaha-Council Bluffs area.

2. The purpose of the wastewater management study is to develop wastewater systems for the area that will best satisfy the various needs in the Omaha-Council Bluffs region in the next 50 years. The seven counties included in this study are Cass, Douglas, Sarpy, and Washington Counties in Nebraska and Harrison, Mills, and Pottawattamie Counties in Iowa.

3. The process of developing alternative plans for wastewater management must consider many factors. These factors are defined in Sections 201 and 208 of Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972. The factors are listed below with reference to the primary sectior of the law which specifies the factor.

- Develop areawide management - Sec. 201(c) and Sec. 208.

- Integrate wastewater systems with land use patterns - Sec. 201(f) and Sec. 208.

- Consider all available technologies - Sec. 201(b).

- Consider recycling of potential sewage pollutants - Sec. 201(d).

- Consider waste flow reduction - Sec. 208.

- Consider all wastewater sources - Sec. 201(c) and Sec. 208 (b)(2).

- Consider environmental and social impacts - Sec. 208(b)(2)(E).

4. Following is a brief description of the relationship of these factors to the wastewater management study.

- Areawide management - This factor encompasses three study areas; the 100-mile radius for land treatment potential, the seven-county area for inventory and analysis, and the urban area for more detailed analysis.

- **Wastewater and Land Use - Four possible growth concepts representing different land use goals and objectives are considered in the study.**

- **Technology - Both high-level conventional treatment and land application treatment systems are considered.**

- **Wastewater Sources - The study considers municipal sources, industrial sources, and stormwater runoff sources. The runoff sources include urban runoff, combined sewer overflows, and agricultural runoff.**

- **Impact Assessment - The impacts of the components of each plan are inventoried and an evaluation is made.**

Study Participants

5. The MAPA Comprehensive Water Pollution Control Plan completed in 1972 outlined the steps required to implement secondary treatment for most domestic wastes in the urban area. This planning effort is intended to extend the MAPA plan in accordance with the goals and objectives of PL 92-500.

6. This annex summarizes the work of two consultants, the staff of the Corps of Engineers, and the city of Omaha. Harza Engineering Company prepared a report on a specific wastewater problem in Omaha

entitled, "Alternative Plans for Abatement of Pollution from Combined Sewer Overflows - Omaha, Nebraska". Alternatives from the Harza report were then incorporated into a comprehensive wastewater management report by Havens and Emerson, Ltd. entitled, "Regional Wastewater Management Study, Omaha-Council Bluffs". The Corps of Engineers, Omaha District, further analyzed the results of the two reports. Infiltration/inflow analyses were conducted by the Corps of Engineers and the cities of Omaha and Council Bluffs.

7. The objective of the Harza Study was to identify and formulate solutions, consistent with PL 92-500, to the problems of pollution caused by combined sewer overflows in the Omaha-Missouri River sewerage system. The latter phase of the study consisted of refining selected alternative concepts to the level of alternative plans. The investigations described in the report, and the alternative plans that were formulated are essentially restricted to the combined sewer overflow problem in the Omaha-Missouri River drainage area.

8. The Harza investigations were required for incorporation into a comprehensive wastewater management planning study. This comprehensive study was performed by Havens and Emerson and included an inventory, evaluation, and projection of municipal wastewater sources including domestic, industrial, and stormwater runoff wastewater. These data were used to develop a range of alternative wastewater management plans, later refined to three basic plans and one major land treatment option.

9. In order to make a final selection of a plan for implementation, the wastewater management study must be integrated with the other portions of the Urban Study for interactions with water supply,

recreation, flood control, and other factors, and the integrated plans evaluated on environmental, social, and economic bases. The staff of the Corps of Engineers made this integration and evaluation.

10. During the course of the wastewater management study and related studies, many organizations provided information and comments on the various aspects of wastewater that are to be summarized in this report. The following is a list of the organizations which contributed to the study effort:

U. S. Environmental Protection Agency

Nebraska Department of Environmental Control

Nebraska Natural Resources Commission

Nebraska Office of Planning and Programming

Iowa Department of Environmental Quality

Metropolitan Area Planning Agency

Riverfront Development Department

Papio Natural Resources District

Metropolitan Utilities District

City of Omaha Public Works Department

City of Omaha Planning Department

City of Omaha Administrators

Council Bluffs Public Works Department

City of Carter Lake

City of Bellevue

Other area communities and their public works departments

SECTION B

BACKGROUND FOR WASTEWATER MANAGEMENT PLANNING

SECTION B

BACKGROUND FOR WASTEWATER MANAGEMENT PLANNING

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SECTION B

BACKGROUND FOR WASTEWATER MANAGEMENT PLANNING

Regional Wastewater Summary

GENERAL DESCRIPTION

1. The study area includes the seven counties around Omaha, Nebraska and Council Bluffs, Iowa, which are Cass, Douglas, Sarpy, and Washington Counties in Nebraska, and Harrison, Mills, and Pottawattamie Counties in Iowa. The Missouri River bisects the area in a north-south direction and the Platte River discharges drainage from Nebraska into the Missouri River just south of Omaha.

2. The significant topographic features of the study area consist of the Missouri River and Platte River valleys surrounded by steep bluffs, rolling hills, and flat plains to the west. The valley areas are flat, with river deposited soils and high ground-water tables. The bluffs are rugged and irregular, with exposed bedrock materials in some areas. The rolling hills are primarily glacial till which is eroded and mantled with loess. The plains area of Saunders, Butler, and Seward Counties is very flat land laying above

the valley. The bedrock formations, consisting of subsurface sandstones and shales with deeper limestones, are generally greater than 20 feet in depth except in the bluffs area where outcropping exists.

3. The average monthly temperatures range from below 20°F. in the winter to above 80°F. in the summer. Extremes of -32°F. to 114°F. have occurred. The urban rainfall is about 28 inches per year, varying from 0.8 inch to 4.5 inches per month, and decreasing toward the western areas and increasing toward the eastern areas. Class A pan evaporation in Omaha is about 55-60 inches, increasing to the west and decreasing to the east.

POPULATION

4. Table B-1 shows the population changes that have occurred in the past decade for the seven counties in the study area. The move from the rural areas and the urbanization of Sarpy County are significant. The entire area is generally showing an increase in population above the national average.

LAND USE

5. Drainage areas, illustrated in figure B-1, were established in areas that may be affected by the future growth of the metropolitan area and also in areas that have an effect on the proposed Papillion Creek reservoir projects. The total acreages and the present land use for these drainage areas are presented in table B-2. This table provides information useful in evaluating the relative

magnitude of land usage, including total acreage and a breakdown of residential, industrial and commercial, feedlots, cropland, other rural land, and open/public land uses.

Wastewater Sources

MUNICIPAL SOURCES

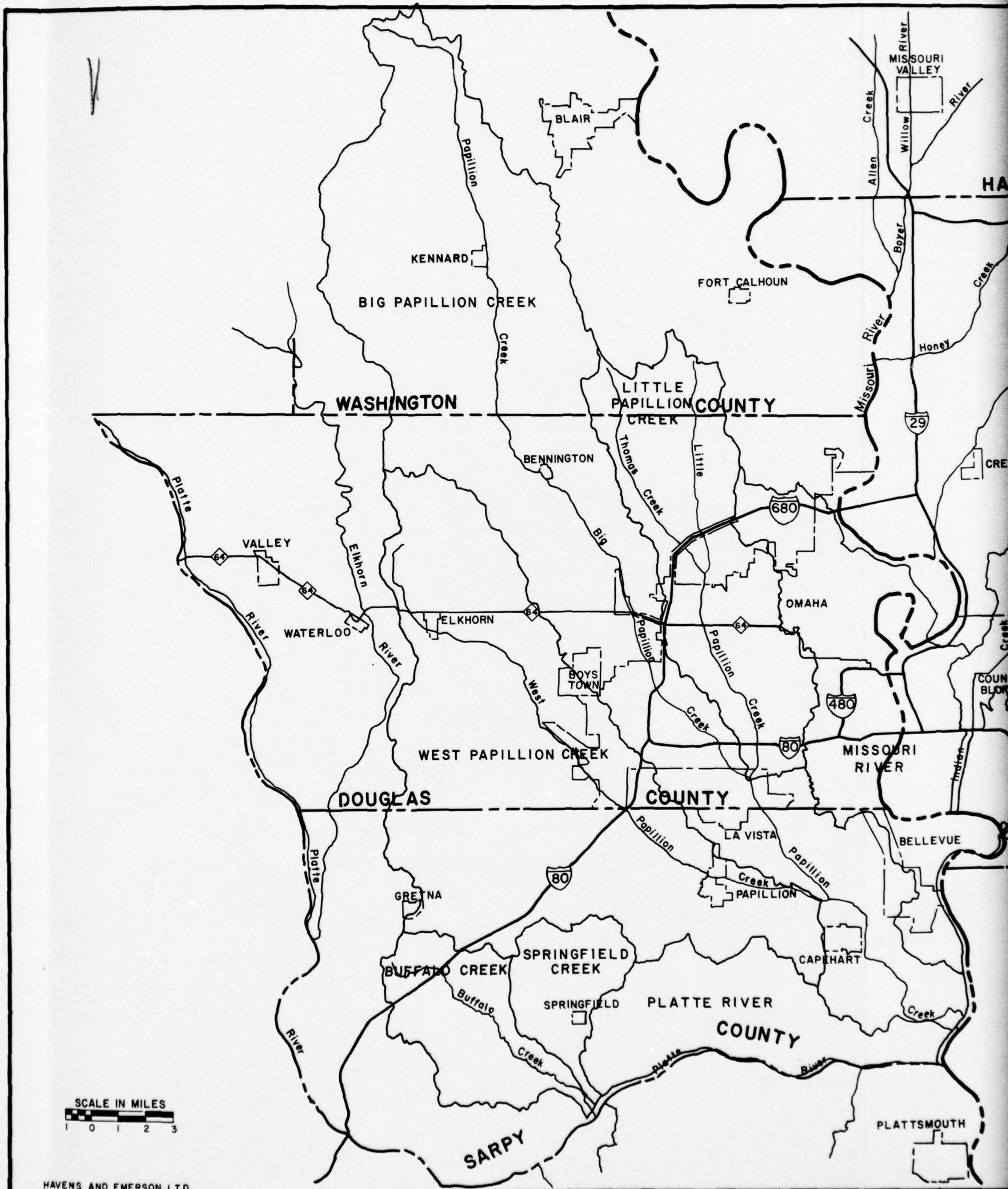
6. Figure B-2 and table B-3 show the current wastewater facilities inventoried for the area. About 100 facilities were identified each with a capacity of greater than 5,000 gallons per day. Many of these facilities are currently scheduled to be placed into regional systems via sewer extensions.

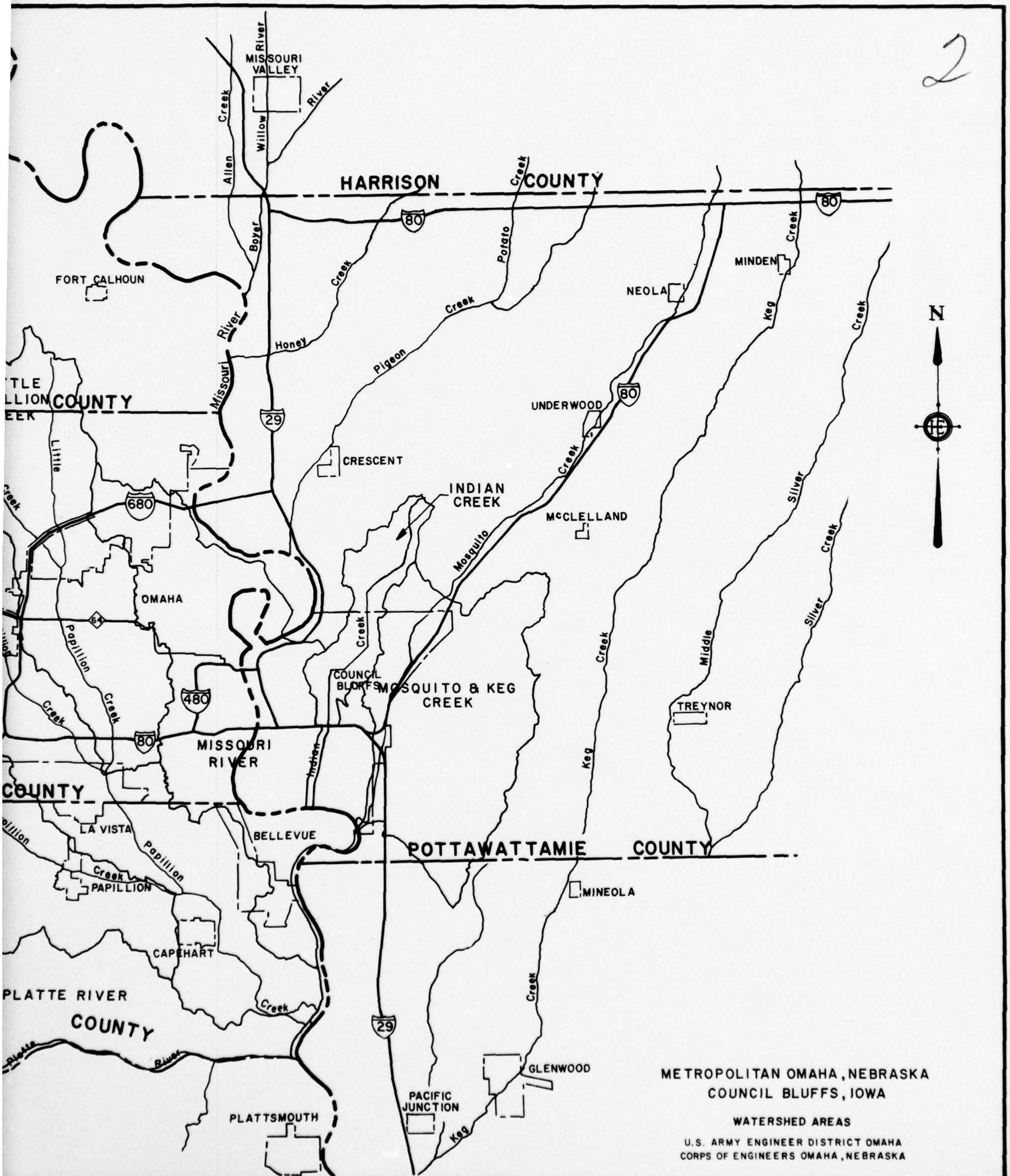
7. Table B-4 lists the municipal wastewater treatment plants of capacity larger than 5,000 gallons per day, which were individually considered in this study. The municipal plants have been grouped in the following categories: major urban, minor urban, and non-urban. The major urban plants are the largest wastewater treatment plants and therefore have the greatest effect on the wastewater management study. The minor urban plants include those of outlying communities which are potentially affected by the future growth of the metropolitan area. The non-urban plants include outlying communities which will probably not be affected by the growth of the metropolitan area.

Table B-1

SEVEN COUNTY POPULATION SUMMARY

County	1960 Population			1970 Population			1960-1970 Percent Change of	
	Total	Urban	Rural	Total	Urban	Rural	Urban	Rural
Cass	17,821	6,244	11,577	18,076	6,371	11,705	+2.0	+1.1
Douglas	343,490	323,736	19,754	389,455	373,160	16,295	+15.3	-17.5
Harrison	17,600	3,567	14,033	16,240	3,519	12,721	-1.4	-9.4
Mills	13,050	4,783	8,267	11,832	4,195	7,411	-12.3	-10.4
Pottawattamie	83,102	60,547	22,555	86,991	64,847	22,144	+7.1	-1.8
Sarpy	31,281	14,429	16,852	63,696	53,769	9,927	+272.6	-41.1
Washington	12,103	4,931	7,172	13,310	6,106	7,204	+23.8	+0.4
Study Area Totals	518,447	418,237	100,210	599,374	511,967	87,407	+22.4	-12.8


MISSOURI VALLEY
Willow River
River
Allen Creek
Boyer River
BLAIR
Papillion Creek
KENNARD
FORT CALHOUN
BIG PAPILLION CREEK
Creek
Honey Creek
Missouri River
LITTLE PAPILLION CREEK
WASHINGTON COUNTY
29
BENNINGTON
Thomas Creek
Little
680
Platte River
VALLEY
64
Elkhorn River
Big Papillion
OMAHA
WATERLOO
ELKHORN
BOYS TOWN
West
Papillion Creek
480
80
WEST PAPILLION CREEK
MISSOURI RIVER
Indian Creek
DOUGLAS COUNTY
LA VISTA
BELLEVUE
Papillion Creek
Papillion
Platte
GRETNA
PAPILLION
SPRINGFIELD CREEK
BUFFALO CREEK
CAPEHART
Buffalo Creek
SPRINGFIELD
PLATTE RIVER
COUNTY
Platte River
River
SCALE IN MILES
1 0 1 2 3
PLATTSMOUTH
SARPY
HAVENS AND EMERSON, LTD.



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

WATERSHED AREAS

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

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Table B-2
SUMMARY OF EXISTING LAND USE (ACRES)

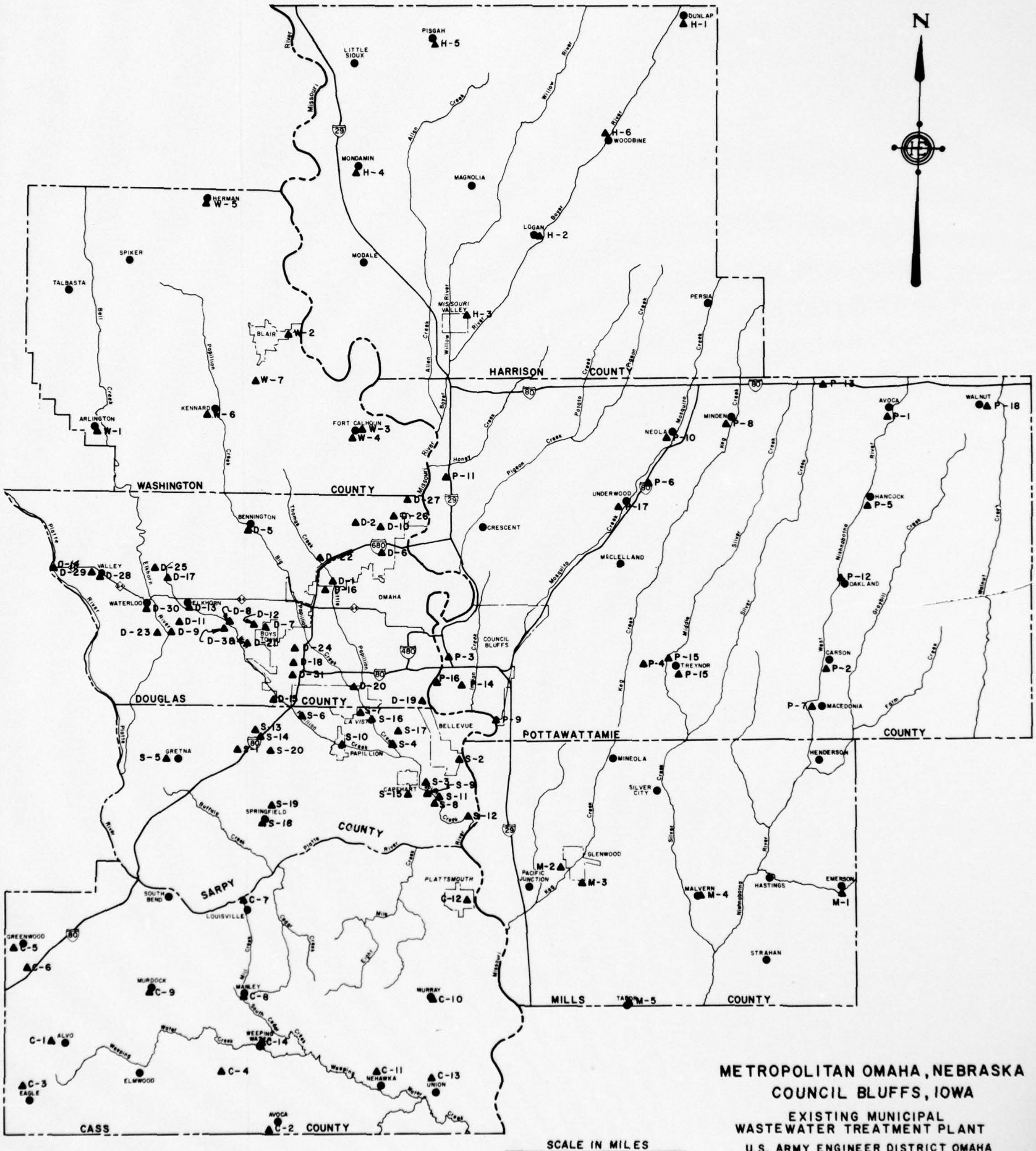
Drainage Area	Total Area	Residential	Industrial & Commercial	Feedlots	Cropland	Other Rural	Open/Public
Big Papillion Creek	127,492	13,846	4,448	1,577	56,455	46,172	4,994
Buffalo Creek	17,137	--	--	277	11,802	5,058	--
Indian Creek	8,523	2,186	545	--	1,622	4,170	--
Little Papillion Creek	38,808	13,750	1,322	--	11,977	8,323	2,936
Missouri River (Iowa)	14,405	1,556	569	--	3,077	7,908	1,295
Missouri River (Neb.)	32,968	13,970	4,956	--	--	8,117	5,925
Mosquito & Keg Creek	34,596	1,343	--	--	14,628	15,612	3,013
Platte River	24,366	--	--	44	15,323	8,999	--
Springfield Creek	10,684	132	7	85	7,740	2,720	--
West Papillion Creek	86,810	2,961	2,979	277	56,952	21,909	1,732
TOTAL	395,789	49,744	15,326	2,260	179,576	128,988	19,895

Table B-3

WASTEWATER TREATMENT PLANTS

Ref. No.	Treatment Plant	Type* of Plant	Design Flow (mgd)	Current Flow (mgd)	Data Year	Influent Suspended Solids (mg/l)	Influent 5-Day BOD (mg/l)	Effluent Suspended Solids (mg/l)	Effluent 5-Day BOD (mg/l)	Receiving Stream	Remarks
Cass County, Nebraska											
C1	Alvo	WSL-1 Cell	0.012	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Dee Creek	Satisfactory operation
C2	Avoca	E	0.025	N.D.	1974	N.D.	N.D.	N.D.	N.D.	S. Branch Weeping Water Creek	Good plant operation
C3	Eagle	A-D	0.040	0.06	1973	N.D.	N.D.	N.D.	N.D.	Hooper Cr. to Little Nemaha Riv	Poor performance; new plant being designed
C4	Elmwood	**	0.050	N.D.	1974	N.D.	N.D.	N.D.	N.D.	N. Branch Weeping Water Creek	Overloaded
C5	Greenwood	WSL-1 Cell	0.028	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Salt Creek	Good performance
C6	Greenwood (Sid #2)	E	0.009	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Platte River	
C7	Louisville	A-D	0.20	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Platte River	
C8	Manley	ARL	0.013	N.D.	1974	N.D.	N.D.	N.D.	N.D.	S. Cedar Creek	
C9	Murdock	WSL	0.017	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Farm Pond to Weeping Water Cr.	
C10	Murray	I	0.04	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Rock Creek	
C11	Nehawka	A	0.025	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Weeping Water Cr.	Good performance
C12	Plattsmouth	P-D	0.70	0.558	1973	166	181	91	163	Missouri River	Good performance
C13	Union	WSL-2 Cell	0.037	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Dry Ditch to Weeping Water Cr.	Good performance
C14	Weeping Water	P	0.20	0.075	1974	N.D.	N.D.	N.D.	N.D.	Weeping Water Cr.	Fair performance

N.D. - No Data Available
* - See Key following last page of table.



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

EXISTING MUNICIPAL
WASTEWATER TREATMENT PLANT

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

HAVENS AND EMERSON, LTD.

Table B-3 (Cont'd)

WASTEWATER TREATMENT PLANTS

Ref. No.	Treatment Plant	Type * of Plant	Design Flow (mgd)	Current Flow (mgd)	Data Year	Influent Suspended Solids (mg/l)	Influent 5-Day BOD (mg/l)	Effluent Suspended Solids (mg/l)	Effluent 5-Day BOD (mg/l)	Receiving Stream	Remarks
Douglas County, Nebraska											
D1	AAA Mobile Homes	-	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	-	Septic tanks, treatment plant proposed
D2	AF Radar Station	WSL	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Little Papillion	Very little flow
D3	Atkins Mobil Homes	E	0.018	0.048	1970	237	202	167	142	West Papillion	Overloaded
D4	Atkins New Plant	E	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	West Papillion	Poor operation
D5	Bennington	E	0.100	0.078	1970	241	204	37	32	Big Papillion	Good operation
D6	Boniwell Estates	WSL-1 Cell	0.007	0.013	1970	N.D.	253	N.D.	37	Little Papillion	0.59 Acres; unsatisfactory operation
D7	Boystown	TF-D	0.200	0.100(.15)	1970(1971)	240	204	36	31	Hell Creek to West Papillion	Good operation
D8	Carat Homes	E	0.015	0.021	1970	245	205	171	143	West Papillion	Overloaded; unsatisfactory operation
D9	Chapel Hill (Sid #57)	WSL-2 Cell	0.067	0.022	1970	240	201	38	33	Boxelder Creek to West Papillion	
D10	County Squire (Sid #135)	WSL-1 Cell	0.007	0.0064	1970	299	261	37	37	Ponca Creek to Missouri River	Is to enter Omaha system in 1975
D11	Crest Mobile Homes	E	0.050	0.040	1970	240	204	36	30	Elkhorn River	Fair performance
D12	Eldorado (Sid #206)	WSL-3 Cell	0.085	(0.12)	1970(1971)	N.D.	200	N.D.	30	N. Branch of West Papillion	Good operation
D13	Elkhorn	A-D-DB	0.085	0.118	1970	240	204	37	30	West Papillion	Proposed sewage treatment plant
D14	Ginger Cove (Sid #196)	WSL-1 Cell	0.012	0.008	1970	240	210	30	30	Platte River	1.28 acre lagoon
D15	Holling Heights	CS	1.250	1.01(1.25)	1973(1974)	305	183	54	31	West Papillion	Good overall treatment; owned by City of Omaha
D16	Knolls (Sid #229)	TF	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Little Papillion	
D17	Mt. Michael & Benedictine High School	A-D	0.025	N.D.	1974	N.D.	N.D.	N.D.	N.D.	West Papillion	Good operation
D18	Oak Hills	TF-D	0.21	0.12(0.31)	1970(1974)	174(475)	185(124)	28(79)	20(42)	West Papillion	50% Western Electric domestic + 50% residential; owned by City of Omaha. To be abandoned when new Papillion plant is in operation.
D19	Omaha-Missouri	P-D-VF	72	38.4(21.9)	1970(1973)	510(837)	563(789)	201(343)	347(659)	Missouri River	Secondary treatment by 1975; owned by City of Omaha
D20	Omaha-Papillion	S-(18 mgd) P-(26 mgd)	26	24.1(24.8)	1970(1974)	260(271)	250(195)	112(172)	63(108)	Big Papillion	Plant effluent was tied to Papillion interceptor in 1974; overloaded; owned by City of Omaha
D21	Pacific Heights (Sid #126)	WSL-2 Cell	0.024	0.04	1970	240	204	168	143	West Papillion	Satisfactory operation
D22	Peaceful Valley Mobile Homes	WSL-1 Cell	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Thomas Creek to Little Papillion	
D23	Riverside Lake	E	0.01	0.01	1970	240	204	34	34	Elkhorn River	Poor performance
D24	Signal Hill (Sid #124)	WSL-1 Cell	0.008	0.01	1970	N.D.	200	N.D.	N.D.	Hell Creek to West Papillion	0.7 acre cell
D25	St. John Seminary	A	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	West Papillion	Effluent to pond
D26	Twilight Hills (Sid #128)	E	0.050	0.045	1970	240	200	35	29	Ponca Creek to Missouri River	To enter Omaha system in 1975
D27	Uta Halee Omaha Home For Girls	E	0.01	0.003	1970	240	200	40	40	Missouri River	Expected to enter Papillion system when service is extended.
D28	Valley	TF-DB	0.30	0.160	1970	239	202	36	31	Elkhorn River	
D29	Valmont Industries	E	0.014	0.014	1970	376	316	60	51	Platte River	Domestic waste only
D30	Waterloo	I-A-DB	0.075	0.059(0.060)	1970(1974)	254	233	101	164	Elkhorn River	Good operation
D31	Westwood (Sid #31)	TF-D	0.70	1.10(1.40)	1970(1973-4)	154(289)	173(150)	54(123)	35(59)	Hell Creek to West Papillion	Owned by City of Omaha. Overloaded, plant to be abandoned when interceptor is completed

N.D. - No Data Available
* - See Key following last page of table.

Table B-3 (Cont'd)

WASTEWATER TREATMENT PLANTS

Ref. No.	Treatment Plant	Type* of Plant	Design Flow (mgd)	Current Flow (mgd)	Data Year	Influent Suspended Solids (mg/l)	Influent 5-Day BOD (mg/l)	Effluent Suspended Solids (mg/l)	Effluent 5-Day BOD (mg/l)	Receiving Stream	Remarks
Sarpy County, Nebraska											
S1	Antilles Corp. (Sid #51)	WSL-2 Cell	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	South Papillion	Fair operation
S2	Bellevue #1	P-D	0.90	0.74	1970	189	235	66	160	Missouri River	Secondary by 1975
S3	Bellevue #2	TF-VF	1.0 Sec. 2.0 Prim.	0.6 Sec. 1.25 Prim.(1.20)	1970(1974)	240	204	107	76	Big Papillion	Has option to go to Papillion system
S4	Blue Ridge (Sid #14)	A	0.062	0.063	1970	186	490	29	25	Squaw Creek to Big Papillion	Good operation
S5	Gretna	CS	0.250	0.160	1970	234	198	35	30	Elkhorn River	Good operation; to be abandoned when Papio Creek plant is completed
S6	Jacobson	P-RBD	1.5	(0.45)	1973(1974)	712	193	99	39	West Papillion	Overloaded; only 50% of plant is in operation; owned by City of Omaha
S7	La Vista	CS	0.50	0.576(.72)	1970(1974)	200	170	30	51	Big Papillion	To be abandoned when Papio Creek plant is completed
S8	Normandy Hills #67	WSL-2 Cell	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Papillion	Good operation
S9	Offut A.F.B.	TF-D	1.00	1.115	1970	206	174	31	26	Big Papillion	To Papillion interceptor (1973)
S10	Offut A.F.B. Lab	Z	0.085	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Storm Sewer to Papillion	Silver recovery unit
S11	Papillion	CS	0.500	0.498(0.75)	1970(1974)	200	180	30	27	West Papillion	Overloaded; interceptor may be used to divert some of load
S12	Papillion Creek Plant	P	50	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Missouri River	Bids have been received
S13	Sapp Brothers Lagoon (Sid #48)	WSL	0.024	N.D.	1974	N.D.	N.D.	N.D.	N.D.	South Papillion	
S14	Sid #52	WSL	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	South Papillion	
S15	Southdale (Sid #25)	A	0.032	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Papillion Creek	1973 - Good operation; to go into proposed Papillion interceptor
S16	Southern Park (Sid #83)	WSL-1 Cell	0.120	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Big Papillion	Poor operation; at present complete retention
S17	Southern View (Sid #20)	E	0.065	0.065	1970	240	138	37	20	Squaw Creek to Big Papillion	
S18	Springfield	I-TF	0.059	0.061	1970	167	206	26	31	Springfield Creek to Platte River	Fair operation; secondary by 1974
S19	School District #46	WSL	0.007	0.01	1970	204	204	36	36	Springfield Creek to Platte River	
S20	Westmont (Sid #23)	E	0.01	0.012	1970	230	200	40	30	South Papillion	Good performance

N.D. - No Data Available
* - See Key following last page of table.

Table B-3 (Cont'd)

WASTEWATER TREATMENT PLANTS

Ref. No.	Treatment Plant	Type* of Plant	Design Flow (mgd)	Current Flow (mgd)	Data Year	Influent Suspended Solids (mg/l)	Influent 5-Day BOD (mg/l)	Effluent Suspended Solids (mg/l)	Effluent 5-Day BOD (mg/l)	Receiving Stream	Remarks
Washington County, Nebraska											
W1	Arlington	TF-DB	0.040	0.090	1973	N.D.	N.D.	160	174	Bell Creek to Elkhorn River	Overloaded
W2	Blair	A-D-DB	0.008	0.243	1973	280	170	266	200	Blair Creek	To be replaced with new plant under construction
W3	Ft. Calhoun	WSL	0.022	0.042	1970	N.D.	90	N.D.	54	Drainage Ditch to Missouri River	3.5 acre surface area; fair operation
W4	Ft. Calhoun Power Plant	E	0.007	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Missouri River	Fair perfo mance
W5	Herman	WSL	0.036	0.034	1970	N.D.	N.D.	N.D.	N.D.	Peterson Drainage Ditch to Missouri River	2.5 acre surface area; fair performance
W6	Kennard	WSL-2 Cell	0.052	0.030	1972	N.D.	N.D.	N.D.	N.D.	Big Papillion	Good performance
W7	Rose Ann Mobile Home Park	WSL-2 Cell	0.027	N.D.	1974	N.D.	N.D.	N.D.	N.D	Hinz Creek	Good performance
Harrison County, Iowa											
H1	Dunlap	WSL	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Boyer River	12 acre surface area
H2	Logan	E	N.D.	.1196	1974	N.D.	N.D.	14	N.D.	Boyer River	
H3	Missouri Valley	WSL	N.D.	.111	1974	N.D.	N.D.	N.D	N.D.	Willow River	39 acre surface area
H4	Mondamin	WSL	N.D.	.044	1974	N.D.	N.D.	N.D.	N.D.	Spooner Drainage Ditch	
H5	Pisgah	WSL	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Soldier River	
H6	Woodbine	WSL-2 Cell	N.D.	.084	1974	N.D.	N.D.	N.D.	N.D.	Boyer River	22 acre surface area
Mills County, Iowa											
M1	Emerson	I-P	N.D.	0.059	1974	N.D.	N.D.	N.D.	N.D.	Nishnobotna	
M2	Glenwood	TF-D	N.D.	0.458	1974	N.D.	N.D.	N.D.	121	Keg Creek	Packing plant and state school have separate treatment facilities.
M3	Glenwood State Hospital	TF	N.D.	0.130	1974	N.D.	N.D.	N.D.	N.D.	Keg Creek	To be phased out into Town of Glenwood
M4	Malvern	L	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Silver Creek	
M5	Tabor	E	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Plum Creek	Treatment system is in Fremont County

N.D. - No data available
* - See Key following page.

Table B-3 (Cont'd)

WASTEWATER TREATMENT PLANTS

Ref. No.	Treatment Plant	Type* of Plant	Design Flow (mgd)	Current Flow (mgd)	Data Year	Influent Suspended Solids (mg/1)	Influent 5-Day BOD (mg/1)	Effluent Suspended Solids (mg/1)	Effluent 5-Day BOD (mg/1)	Receiving Stream	Remarks
Pottawattamie County, Iowa											
P1	Avoca	WSL-2 Cell	0.131	0.121(0.144)	1970(1974)	300	257	45	39	West Nishnobotna	
P2	Carson	TF	0.049	0.060(0.070)	1970(1974)	299	253	45	37	West Nishnobotna	
P3	Council Bluffs	P-D	10.4	6.60(6.86)	1970(1974)	233(684)	288(668)	133(130)	230(264)	Missouri River	Plant to be replaced with new Mosquito Plant when completed
P4	Halverson Center for Education	WSL-2 Cell	N.D.	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Middle Silver Creek	No Discharge
P5	Hancock	WSL-2 Cell	0.025	0.018(0.07)	1970(1974)	292	252	47	40	West Nishnobotna	
P-6	I-80 Rest Area	WSL-2 Cell	0.120	0.120	1970	60	50	10	9	Middle Silver Creek	
P-7	Macedonia	WSL-2 Cell	0.031	0.031(0.012)	1970(1974)	254	216	39	31	West Nishnobotna	Sealing problems
P-8	Minden	WSL-2 Cell	0.045	0.034	1970	444	380	46	39	Keg Creek	Some short circuiting
P-9	Mosquito	TF	14.71	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Missouri River	
P-10	Neola	TF	0.100	0.076	1970	301	255	121	180	Mosquito Creek	
P-11	Nickerson Farms	WSL	0.006	0.006	1970	2,395	2,235	359	339	Dry Run to Missouri River	
P-12	Oakland	WSL-2 Cell	0.150	0.126	1970	298	253	45	38	West Nishnobotna	
P-13	Shelly Station	WSL-2 Cell	0.003	0.003	1970	599	479	80	80	Silver Creek	
P-14	Trailer City	E	0.037	N.D.	1974	N.D.	N.D.	N.D.	N.D.	Indian Creek	Will connect to Council Bluffs
P-15	Treynor	2 Separate WSL-1 Cell	0.054	0.037	1970	301	256	45	39	Middle Silver Creek	S.E. Lagoon - 1.25 acres; N.W. Lagoon - 4.00 acres town served by two separate collection systems
P-16	Twin Cities Plaza	P	0.22	0.26	1970	239	203	92	143	Missouri River	Will connect to Council Bluffs in 1974
P-17	Underwood	WSL-2 Cell	0.077	0.058(0.018)	1970(1974)	301	258	43	34	Mosquito Creek	Sealing problems
P-18	Walnut	WSL-2 Cell	0.104	0.104(.07)	1970(1974)	196	175	30	26	Walnut Creek	6.82 acres

N.D. - No Data Available
* - See Key following last page of table.

WASTEWATER TREATMENT PLANT DESIGNATION KEY

(FOR TABLE B-3)

Symbol	Type of Treatment
A	Activated sludge
ARL	Aerated lagoon
CS	Contact stabilization
D	Digester
DB	Drying beds
E	Extended aeration
I	Imhoff tank
P	Primary
RBD	Rotating biological disks
TF	Trickling filter
VF	Vacuum filter
WSL	Waste stabilization pond
Z	Advanced treatment
**	Spragester and facultative lagoon

Table B-4

MUNICIPAL WASTEWATER TREATMENT PLANTS

I. MAJOR URBAN PLANTS

A. Nebraska
1. Missouri River
2. Papillion Creek

B. Iowa
1. Mosquito Creek

II. MINOR URBAN PLANTS

A. Douglas County, Nebraska
1. Bennington
2. Elkhorn
3. Valley
4. Boys Town

B. Sarpy County, Nebraska
1. Springfield
2. Gretna
3. Bellevue #1

C. Washington County, Nebraska
1. Blair
2. Fort Calhoun

D. Cass County, Nebraska
1. Plattsmouth

E. Harrison County, Iowa
1. Missouri Valley

F. Mills County, Iowa
1. Glenwood

III. NON-URBAN (OUTLYING) PLANTS

A. Washington County, Nebraska
1. Arlington
2. Herman
3. Kennard

B. Cass County, Nebraska
1. Weeping Water
2. Union
3. Nehawka
4. Murray
5. Murdock
6. Manley
7. Louisville
8. Greenwood
9. Elmwood
10. Eagle
11. Avoca
12. Alvo

C. Douglas County, Nebraska
1. Waterloo

D. Harrison County, Iowa
1. Logan
2. Woodbine
3. Mondamin
4. Dunlap
5. Pisgah

E. Pottawattamie County, Iowa
1. Avoca
2. Carson
3. Hancock
4. Macedonia
5. Minden
6. Neola
7. Oakland
8. Treynor
9. Underwood
10. Walnut

F. Mills County, Iowa
1. Emerson
2. Malvern
3. Tabor

INDUSTRIAL SOURCES

8. In the seven-county area, there is a fairly wide diversity of industrial employment. It was found, however, that only six industrial categories contribute significantly to wastewater flows with concentrations greater than domestic flows. These are SIC's 20, 28, 33, 34, 35, and 36. The remaining industrial categories are lumped together here under the classification "other". The combined flow for the "other" category is estimated to represent about 10 percent of the total process water.

Standard Industrial Classification	Description
20	Food and kindred products
28	Chemicals
33	Primary metals
34	Fabricated metals
35	Machinery except electrical
36	Electrical equipment and supplies

9. Table B-5 summarizes the estimates of existing industrial wastewater flows. It can be seen that, at present, 64 percent of all industrial flows are concentrated in the Missouri River Plant Sanitary District, and that the food processing industry (SIC 20) - primarily meat packing - contributes 60 percent of the total process water flow. With the exception of the chemicals and allied products industry (SIC 28), cooling water flows are practically insignificant. It should be noted that about 62 percent of the SIC 20 flow in the Missouri River Plant Sanitary District is pretreated in the Omaha Pollution Control Corporation (OPCC) plant now owned and operated by the city of Omaha.

10. The estimates of existing industrial wastewater contaminate loads are summarized in table B-6. As indicated in the table, the predominance of SIC 20 in its contribution to the wastewater flows is even more marked in the case of contaminant loads. For example, it is estimated that SIC 20 accounts for 70 percent of the BOD, 86 percent of the TSS, and 95 percent of the oil and grease. It should be noted that 71 percent of this load is generated by those individual meat-packing firms whose wastewaters are being pretreated by the OPCC Plant. The only other significant loads are those of SIC 28, which are principally generated by one agrichemical plant. This source accounts for 98 percent of the BOD and 21 percent of the TSS in SIC 28. This ratio of BOD to TSS indicates, incidentally, that the load is essentially water soluble.

11. The "other" group of industries as defined above has been treated specially with respect to contaminant loads. It has been assumed that concentrations for the "other" category are equivalent to those of domestic municipal sewage. It is felt that this assumption is a conservative one.

12. In general, no significant quantities of incompatible industrial wastewater loads were identified in conducting the inventory.

13. Industrial and municipal (domestic) loads for individual major urban and minor urban wastewater treatment plants are compared in tables B-7 and B-8.

TABLE B-5

INVENTORY OF SIGNIFICANT INDUSTRIAL WASTEWATER FLOWS IN THE SEVEN COUNTY AREA
(Million Gallons Per Day)

SIC	20			28			33			34			35			36			Other (1)			Total		
	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total	Process	Cooling	Total
7 County Area	17.790	0.128	17.918	2.033	24.470	20.743	0.959	0.056	1.015	0.147	0.034	0.181	0.307	0.009	0.316	1.012		10.012	7.416		7.416	29.664	24.697	54.361
Papillion Sanitary District	1.114	0.008	1.122							0.006	0.027	0.033				0.950		0.950	.690		.690	2.760	0.035	2.795
Council Bluffs Sanitary District	3.300		3.300				0.009	.002	0.011							0.007		0.007	1.105		1.105	4.421	0.002	4.423
Missouri River Sanitary District	11.876	0.110	11.986	1.533	0.210	1.743	0.420	.012	0.432	0.141	0.007	0.148	0.082	0.006	0.088	0.055		0.055	4.736		4.736	18.943	0.245	19.188
Rivers & Streams	1.430	0.010	1.440	0.500	24.260	19.000	0.530	0.042	0.572				0.220	0.003	0.332				0.890		0.890	3.570	24.315	27.885
Rural City Sewers	0.070		0.070										0.005		0.005				0.025		0.025	0.100		0.100

Note: (1) Represents an estimate for the industrial flows of the SIC's not specifically listed in this exhibit (25% of total for process water only.

Source: Interviews with Industries and Agencies

TABLE B-6

INVENTORY OF SIGNIFICANT INDUSTRIAL LOADS IN THE SEVEN COUNTY AREA

Lbs. Per Day

	SIC 20			SIC 28			SIC 33			SIC 34			SIC 35			SIC 36			"Other"			Total		
	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G	BOD	TSS	O&G
County Area	161,137	162,013	78,488	61,425	17,215	1,275	217	226	10	2	2	2	60	19	7	749	225	37	7,680	8,957	2,386	231,330	188,657	82,805
pillion Sani-ary District	9,597	2,532	1,953							1	1	1				700	210	32	211	245	82	10,508	2,988	2,068
uncil Bluffs Sanitary District	29,695	27,145	12,985				72	200	4							7	2	3	326	380	126	30,100	27,727	13,118
ssouri River Sanitary District	121,161	131,566	63,505	61,425	17,215	1,275	145	26	6	1	1	1	60	19	7	42	13	2	7,143	8,332	2,778	189,977	157,172	67,574
vers & Streams	455	525	25																			455	525	25
al City Sewers	289	245	20																			289	245	20

urce Interviews with Industry and Agencies.

Table B-7

EXISTING MAJOR URBAN WASTEWATER TREATMENT PLANT
AVERAGE DAILY FLOWS AND LOADS

Plant	Population	Type of Waste	Flow (mgd)	BOD_5 (lbs/day)	SS (lbs/day)	N (lbs/day)	P (lbs/day)
Council Bluffs	64,005	Domestic	6.0	11,521	13,441	1,920	576
		Industrial	2.4	10,509	2,988	1,051	105
		Total	8.4	22,030	16,429	2,971	681
Missouri River	189,536	Domestic	17.8	34,116	39,803	5,686	1,706
		Industrial	18.6	189,997	157,172	18,998	1,900
		Total	36.4	224,113	196,975	24,684	3,606
Papillion Creek*	252,670	Domestic	23.8	45,479	53,061	7,581	2,382
		Industrial	2.3	10,509	2,988	1,051	105
		Total	26.1	56,088	56,049	8,632	2,487

*The entire Papillion sanitary district is assumed to contribute to this plant by 1975.

Table B-8

EXISTING MINOR URBAN WASTEWATER TREATMENT PLANT
AVERAGE DAILY FLOWS

Treatment Plant	Population	Domestic Flow (mgd)	Industrial Flow (mgd)	Total Flow (mgd)
Bennington	683	0.064	0	0.064
Elkhorn	1,184	.111	.042	.153
Valley	1,595	.150	.063	.213
Springfield	795	.075	0	.075
Gretna	1,557	.146	0	.146
Bellevue	9,303	.874	0	.874
Blair	6,106	.574	.068	.642
Fort Calhoun	642	.060	.315	.375
Plattsmouth	6,371	.599	.002	.601
Missouri Valley	3,519	.331	0	.331
Glenwood	4,421	.416	.011	.427
TOTAL	36,176	3.400	0.501	3.901

Stormwater Sources

14. To evaluate the effects of stormwater runoff, the existing annual average runoff volumes and accompanying loads were determined. Such annual volumes and loads, which are derived from data obtained from monitoring runoff events in the past, indicate trends that may be expected as rural lands become urbanized.

15. Annual loads and volumes were computed using various factors defining average runoff volumes per acre and average pollutant concentrations per volume of runoff. Factors were selected which characterized runoff for each type of land use. A summary of runoff volumes per acre for the various land uses in the study area are given in table B-9.

16. Concentrations of pollutants that are washed off the land into receiving bodies of water vary greatly with the type of land use. Average concentrations are illustrated in table B-10.

17. The average annual pollutant load due to stormwater runoff can be obtained by multiplying the number of acres in each category by the mean annual runoff and the average annual stormwater runoff concentrations of pollutants parameters for each land use category. The results of these computations are shown in table B-11 for the existing land use according to watersheds in the study area.

18. *The relatively high BOD loads* contributed by Little Papillion Creek and the Missouri River watershed in relation to runoff volumes are due to the existence of combined sewers in these two areas.

Table B-9

MEAN ANNUAL RUNOFF BY LAND USAGE

TYPE OF LAND USE	ANNUAL VOLUME (ft^3/acre)
Residential (2-5 people/acre)	17,500
Residential (5-8 people/acre)	21,000
Residential (8-12 people/acre)	24,500
Residential (12-15 people/acre)	28,000
Residential (15-18 people/acre)	31,500
Residential (18-20 people/acre)	35,000
Industrial and Commercial	52,500
Feedlots	33,500
Rural (Iowa)	15,000
Rural (Eastern Nebraska)	10,000
Rural (East-Central Nebraska)	4,000

Table B-10

AVERAGE ANNUAL STORMWATER RUNOFF CONCENTRATIONS OF POLLUTANT PARAMETERS

Land Use	Suspended Solids (mg/l)	BOD_5 (mg/l)	COD (mg/l)	Phosphorus as P (mg/l)	Nitrogen as N (mg/l)
Residential (2-5 ppa)[1]	300	20	150	0.70	3.1
Residential (5-8 ppa)	340	22	160	0.66	2.9
Residential (8-12 ppa)	380	24	170	0.62	2.7
Residential (12-15 ppa)	420	26	180	0.58	2.5
Residential (15-18 ppa)	460	28	190	0.54	2.3
Residential (18-20 ppa)	500	30	200	0.50	2.2
Residential Combined Sewer Overflows	250	100	400	4.00	10.0
Commercial and Industrial	500	30	200	0.50	2.2
Feedlots[2]	7,000	5,000	20,000	30.00	300.0
Iowa Agricultural (Adequate Controls)	3,000	20	30	.20	5.0
Iowa Agricultural (Needing Control)	40,000	25.0	350	2.80	65.0
Iowa Rural (Adequate Controls)	500	0.3	5	.002	1.0
Iowa Rural (Needing Control)	5,000	3.5	50	.04	8.0
Nebraska Agricultural (Adequate Controls)	4,000	3.0	40	.30	7.0
Nebraska Agricultural (Needing Control)	40,000	25.0	350	2.60	65.0

Table B-10 (Cont'd)

AVERAGE ANNUAL STORMWATER RUNOFF CONCENTRATIONS OF POLLUTANT PARAMETERS

Land Use	Suspended Solids (mg/l)	BOD_5 (mg/l)	COD (mg/l)	Phosphorus as P (mg/l)	Nitrogen as N (mg/l)
Nebraska Rural (Adequate Controls)	700	0.6	8	.001	1.0
Nebraska Rural (Needing Control)	4,000	2.5	20	.020	5.0
Open/Public	200	3.0	50	.20	2.0

1 - ppa = people/acre

2 - Concentrations for runoff directly off feedlots.

Table B-11

EXISTING ANNUAL RUNOFF AND POLLUTANT LOADS PER WATERSHED

Watershed *	Runoff (MG)	Suspended Solids (Tons/Yr)	BOD (Tons/Yr)	COD (Tons/Yr)	Phosphorus (Tons/Yr)	Nitrogen (Tons/Yr)
Big Papillion Creek	12,360	570,460	1,010	8,702	45	959
Buffalo Creek	1,331	100,329	367	2,078	8	179
Indian Creek	1,256	24,449	179	965	7	54
Little Papillion Creek	4,819	134,731	765	4,483	32	280
Missouri River	7,229	44,451	1,473	7,061	52	196
Mosquito & Keg Creeks	3,830	182,190	206	2,029	15	307
Platte River	1,831	132,412	114	1,254	8	214
Sattelite Cities	1,092	9,594	62	455	2	18
Springfield Creek	824	65,032	143	976	5	111
West Papillion Creek	7,808	545,953	739	6,859	39	905
	42,380	1,809,601	5,058	34,862	213	3,223

*** See Figure B-1 for location of watershed.**

Summary of Pollutant Loads

19. Table B-12 illustrates the existing annual pollutant loads for the study area. The table shows the influent loadings and relative loads of the major, minor, and non-urban wastewater treatment plants. It also provides a comparison of the total wastewater loads to the total stormwater loads from the defined watersheds as discussed in the previous section. As would be expected, the solids loading from the stormwater runoff (due largely from the agricultural lands) is much more significant than the solids loading from the wastewater treatment plants. But the BOD and nutrient loadings to the wastewater treatment plants are more significant than the loads from the stormwater runoff.

Wastewater Management Plans

20. Existing wastewater management plans of regional significance are the MAPA Comprehensive Water Pollution Control Plan and the States' 303e Basin Water Quality Plans.

Table B-12

EXISTING ANNUAL POLLUTANT LOADS SUMMARY

Source	Volume (MG)	Suspended Solids (Tons)	BOD (Tons)	Phosphorus (Tons)	Nitrogen (Tons)
Wastewater*					
Major Urban	25,879	49,166	55,152	1,241	6,607
Minor Urban	1,424	1,543	1,366	50	208
Non-Urban	803	876	767	37	110
Total Wastewater	28,106	51,585	57,285	1,328	6,925
Total Stormwater**	42,380	1,809,601	5,058	213	3,223
Total Loads	70,486	1,861,186	62,343	1,541	10,148

*Influent Flows and Loads to Municipal Plants

**Total Runoff Volumes and Loads from 9 Watersheds and Satellite Cities

21. The MAPA Plan adopted in 1972 consists of three major wastewater treatment systems: (1) the addition of secondary facilities at the Omaha-Missouri River Sewage Treatment Plant; (2) construction of interceptor sewers along the Little, Big, and West Papillion Creeks, and a new secondary treatment plant at the point where Papillion Creek enters the Missouri River; and (3) construction of an interceptor sewer along Mosquito Creek and a new secondary treatment plant at the point where Mosquito Creek enters the Missouri River.

22. The parts of the MAPA Plan either completed or under construction are: (1) the Mosquito Creek secondary treatment plant; (2) the primary portion of the new Papillion Creek Treatment Plant; and (3) portions of the interceptor sewers along the Papillion Creeks. Elements of the MAPA Plan not under construction have been included in the costs presented in this report.

23. The MAPA Plan was directed primarily to sewage treatment plant regionalization and the provision of secondary treatment for domestic wastes sources. The overall magnitude of the waste sources was also defined in the MAPA Plan.

24. The Nebraska Natural Resource Commission is responsible for preparing Section 303e Basin Water Quality Plans. The Lower Platte Water Quality Plan, which includes Cass County, has been completed. The Missouri Tributaries Water Quality Plan, including most of Washington, Douglas, and Sarpy Counties, is nearing completion. The Elkhorn River Water Quality Plan, including parts of western Washington, Douglas, and Sarpy Counties has been completed.

25. Iowa's Section 303e Basin Water Quality Plans that include portions of the study area are currently under preparation.

Current Wastewater Management

WASTEWATER TREATMENT PLANTS

26. The Nebraska State Department of Environmental Control (DEC) has the prime responsibility for the abatement of pollution of air, water, and land in the State. The "Water Quality Standards Applicable to Nebraska Waters", effective June 1973, require a minimum of secondary treatment and disinfection. The National Pollutant Discharge Elimination System (NPDES) permits program has recently been taken over by the State DEC Water Pollution Control Division from the U. S. Environmental Protection Agency.

27. Semiannual inspection of wastewater treatment plants are conducted by the DEC usually with a county representative. The county representative units in the study area are as follows:

- Washington - County Surveyor
- Douglas - Environmental Health Sanitation, Dept. of Health
- Sarpy - Environmental Control, Dept. of Health
- Cass - County Health Officer (County Sheriff)

28. The State does not require monthly operation reports nor operator certification. Some of the large municipal treatment plants do voluntarily provide operation reports and many treatment plant operators are participating in a recently organized voluntary certification program.

29. The Iowa Department of Environmental Quality (DEQ), Water Quality Management Division, has prime responsibility for wastewater management. Water quality standards were adopted in February 1974 that require such minimum treatment as is necessary to meet the water quality standards as established for the various surface water streams. The State, as part of the wastewater treatment plant operation permit program, requires monthly operation reports but no annual summary. The State also has a mandatory operators certification program. Region 4 of the DEQ, located in Council Bluffs, maintains most of the inspection and enforcement of regulations directly with the municipality, with little individual county input.

30. There exist some 100 municipal wastewater treatment plants of varying size in the study area; 72 in the four Nebraska counties and 28 in the three Iowa counties. Operation reports were obtained and reviewed to establish background data on plant treatment performance. Visual inspections were made of the large wastewater treatment plants, especially of those located in and serving the urban population area.

31. Both of the major municipal wastewater systems in Omaha and Council Bluffs are in varying stages of implementation of the MAPA Plan of September 1972. Omaha is replacing 25 separate plants by two major plants on the Missouri River and on Papillion Creek.

32. The first city of Omaha plant was the Papillion Creek plant, located at South 60th Street; it was built in 1941 and enlarged in 1960. This plant serves the west part of the city which includes several new residential and commercial areas. It has a design capacity of 18.0 mgd for primary treatment and 12.0 mgd for secondary treatment but received an average flow of 25 mgd in 1973. Due to the hydraulic overload with resulting poor treatment performance, however, its operation was changed to primary treatment only, with improved treatment. Additionally, several combined sewer overflow points are reported to exist in the upstream sewer system which serves this plant, resulting in gross pollution of Papillion Creek and some of its branches.

33. The Omaha-Missouri River Plant, built in 1964, has a design capacity of 72 mgd. It provides primary treatment of municipal and pre-treated industrial wastes from the Missouri River drainage basin areas of the city. It receives a split flow - principally municipal wastes to the plant's north inlet and industrial wastes to the south inlet. The plant treated an average of 16 mgd in 1973. According to flow measurements the plant should be receiving approximately 25 mgd on an average annual basis. Sewer system breakdowns are the major reason why all the flow does not reach the treatment plant. The plant has also been receiving an abnormally high-strength industrial flow which has caused operation problems.

34. The Omaha Pollution Control Corporation plant provides pre-treatment of wastes from some 18 meat-packing houses in the stockyards area of South Omaha. This 15 mgd capacity facility, built in 1969, was to provide pre-treatment and by-product recovery of the difficult-to-treat packing wastes. Generally, pre-treatment is being performed fairly well, but the by-product recovery processes

have not developed as anticipated. Consequently, residual waste loadings are being passed on through the sewer system to the Missouri River plant for treatment and disposal. The plant currently receives an average of 5 mgd of high-strength meat-packing wastes.

35. The city of Omaha also operates three smaller treatment plants, the 1.25 mgd contact stabilization Holling Heights plant, the 0.21 mgd trickling filter Oak Hills plant, and the 1.50 mgd biological treatment process Jacobsen plant in adjacent Sarpy County.

36. The new Omaha-Papillion Creek plant will be located southeast of Bellevue at the confluence of the Big Papillion Creek and the Missouri River. This facility will initially provide a 50 mgd primary treatment capacity with expansion planned for a 70 mgd secondary treatment capacity employing the trickling filter process. Construction of site development has started, equipment bids have been awarded, and construction has begun for this plant.

37. The Mosquito Creek treatment plant, completed in late 1974, serves the city of Council Bluffs. This plant, located on a remote site near the south city limits, provides secondary treatment employing high-rate two-stage trickling filters with a design capacity of 12.85 mgd.

38. Existing treatment plants for the other communities in the study area are listed in table B-3 on page B-6.

39. Wastewater collection systems in the study area generally carry sanitary flows only. Extensive combined storm and sanitary flow systems are in use in the old urban sections of Omaha, Council Bluffs, and Plattsmouth. This study does not detail individual overflow points, although prior studies of parts of the combined systems have been made in the Omaha and Council Bluffs areas. A detailed infiltration inflow study is underway for the Plattsmouth combined sewer system. Infiltration/inflow studies were conducted as part of this wastewater management study for the Omaha-Missouri River and Council Bluffs sewer systems.

40. The Missouri River Plant is served by a north-south interceptor which collects flow from 26 combined sewer drainage areas serving approximately 20,000 acres of residential land. The system includes 20 dry-weather-flow diversion structures, 12 grit removal structures, and 11 lift stations. The system is shown in figure B-3. In this collection system, combined sewage flows by gravity toward the Missouri River. At this point, the flow passes through a diversion facility which degrits and pumps dry-weather flow to the north-south interceptor. The interceptor carries the flow to the treatment plant. During the periods of high flow, the diversion structures will deliver either 3 or 5 times the dry-weather flow to the interceptor depending upon their location relative to the Council Bluffs raw-water intake structure across the river. Flows in excess of this ratio are discharged to the Missouri River without treatment. Structures divert excess flow by overflowing diversion dams or by carrying excess in a separate pipe to the river.

41. Grit removal is provided prior to the lift stations. Generally, the method involves an aerated grit chamber with mechanical

removal of grit to the surface for washing, storage, and hauling to land fill. Some facilities integrate the grit removal chamber with the wet pit of the lift station. Operational problems have been encountered with the grit chambers.

42. The remainder of the Omaha sewer system is in separate sewers except for a 5,000 acre area in the Benson-Westside and Saddle Creek areas.

43. The Council Bluffs collection system generally consists of separate storm and sanitary sewers. Approximately 1,000 acres of the older section of the city, however, have combined sewers and there are areas where certain interceptors are suspected to contain overflow relief points. The Plattsmouth collection system is almost totally combined and, according to a current study, it receives very little infiltration.

Area Water Quality

44. Both Nebraska and Iowa have standards which establish the minimum acceptable water quality in lakes and streams.

45. Water quality of the Missouri River, the Papillion Creek basin, the Iowa tributaries, the Platte and Elkhorn Rivers, and Buffalo Creek tributaries has been variously monitored for several years. The data accumulated are stored in files and computer banks of both Nebraska and Iowa and are available on STORET, from U. S. EPA

1


EPPLEY AIRFIELD
CARTER LAKE
CARTER LAKE VILLAGE
COUNCIL BLUFFS
IOWA
GRACE
BURT-IZARD
MINNE LUSA
MORMON
BRIDGE
AIRPORT
SKYRANCH
AIRPORT

LEGEND

EXISTING

SERVICE AREA BOUNDARY

N OMAHA INTERCEPTOR

S OMAHA INTERCEPTOR

COMBINED TRUNK SEWER

SANITARY TRUNK SEWER

COMBINED SEWER OVERFLOW POINT

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

OMAHA-MISSOURI RIVER
SEWERAGE SYSTEM

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE B-3

Region VII, Kansas City, Missouri, and from the State of Iowa Department of Environmental Quality. Figure B-4 depicts the relative water quality of the major streams and rivers in the study area according to the STORET data. All of the area waters violated one or more of the water quality parameters of dissolved oxygen, BOD, fecal coliforms (bacteria), phosphorous, and ammonia nitrogen.

Problems and Needs

46. Water quality management problems and needs can be divided into sewage treatment plants, sewer systems, and stormwater runoff.

SEWAGE TREATMENT PLANTS

47. The most immediate need in the study area is to implement secondary treatment in all treatment plants as required by 1977 under PL 92-500. Neither of Omaha's two largest treatment plants currently provide secondary treatment. It is doubtful that the 1977 deadline can be met on the Missouri River plant or Papillion Creek sewage treatment plant. Fifty-eight other sewage treatment plants in the study area also currently do not meet secondary treatment standards. Data on 22 additional sewage treatment plants, most of them very small plants, were not available from existing data sources. It is suspected that many of these plants also do not meet secondary treatment requirements.

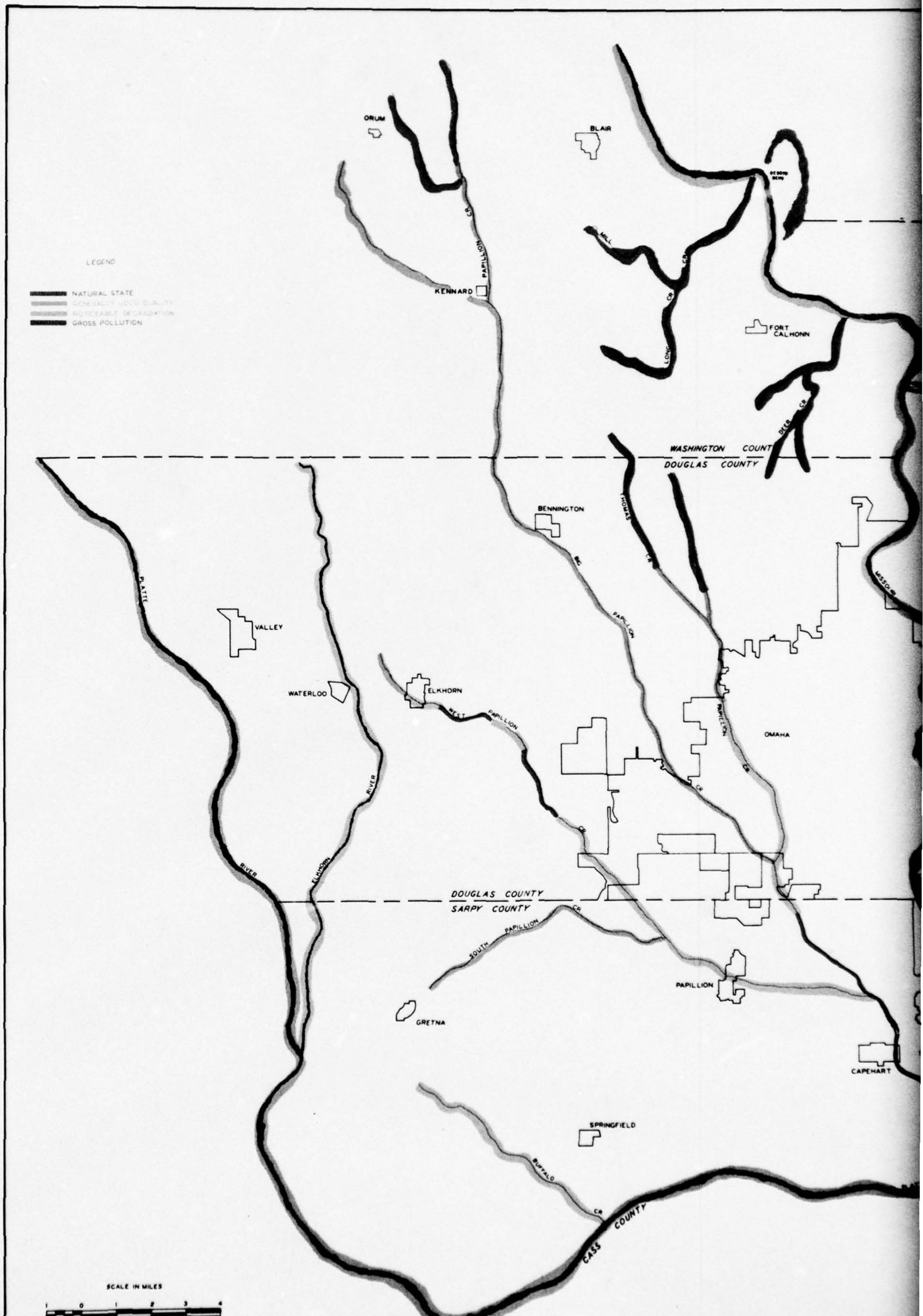
48. A number of small sewage treatment plants, many of them serving sanitary and improvement districts, have been sources of operating, monitoring, and control problems.

49. Following implementation of secondary treatment, some treatment plants will be required to provide additional treatment to meet water quality requirements. This requirement is particularly applicable to the minor urban communities that have a good population growth potential, but whose sewage treatment plants discharge into low flow streams. Figure B-5 shows the water quality effects of the Elkhorn and Bennington sewage treatment plants using 2020 flows. The Nebraska Natural Resource Commission has determined that these two plants will require more than secondary treatment by 1985 to avoid high ammonia levels in Papillion Creek.

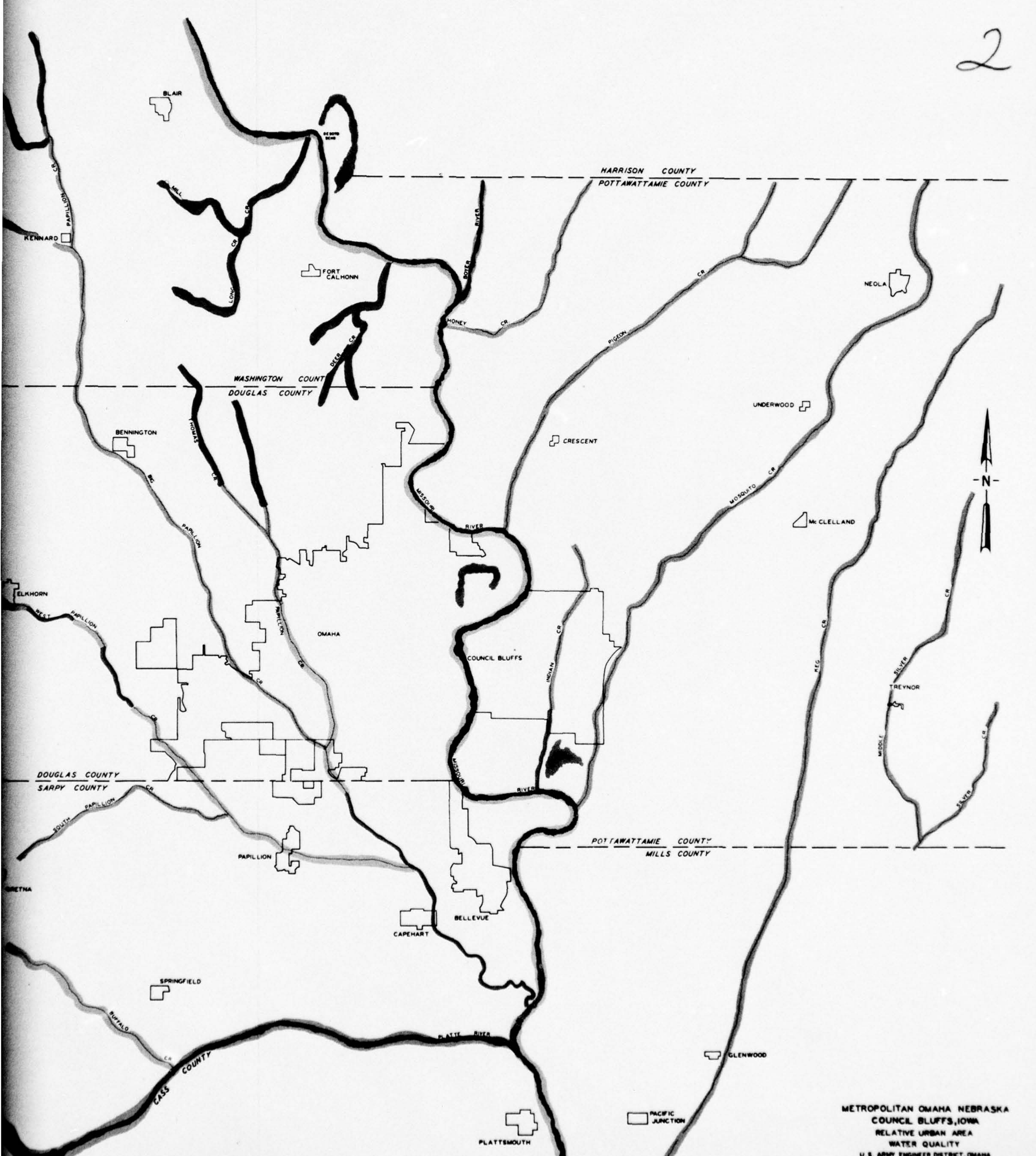
50. It is also suspected that the minor urban communities of Gretna and Springfield will have similar requirements in the future.

SEWER SYSTEM RELIABILITY

51. The major sewer system reliability problem is confined to the sewer system serving the Omaha-Missouri River sewage treatment plant. (See figure B-3.) Mechanical failures in the system have caused considerable by-passing of raw sewage directly to the Missouri River. The city of Omaha estimates that 4.5 billion gallons of raw sewage entered the river in 1973 because the problems with existing grit removal facilities, pumping stations, and diversion structures. The problems are attributable to excessive flow and grit load, depth, corrosion, and odors.



LEGEND
NATURAL STATE
GROSS POLLUTION
ORUM
BLAIR
KENNARD
PAPILLION CR
MILL CR
LONG CR
FORT CALHONN
DEER CR
WASHINGTON COUNTY
DOUGLAS COUNTY
BENNINGTON
THOMAS CR
BIG PAPILLION CR
VALLEY
WATERLOO
ELKHORN
WEST PAPILLION CR
PLATTE RIVER
ELKHORN RIVER
OMAHA
PAPILLION CR
DOUGLAS COUNTY
SARPY COUNTY
SOUTH PAPILLION CR
PAPILLION
GRETNA
CAPEHART
SPRINGFIELD
BUFFALO CR
CASS COUNTY
SCALE IN MILES
1 0 1 2 3 4

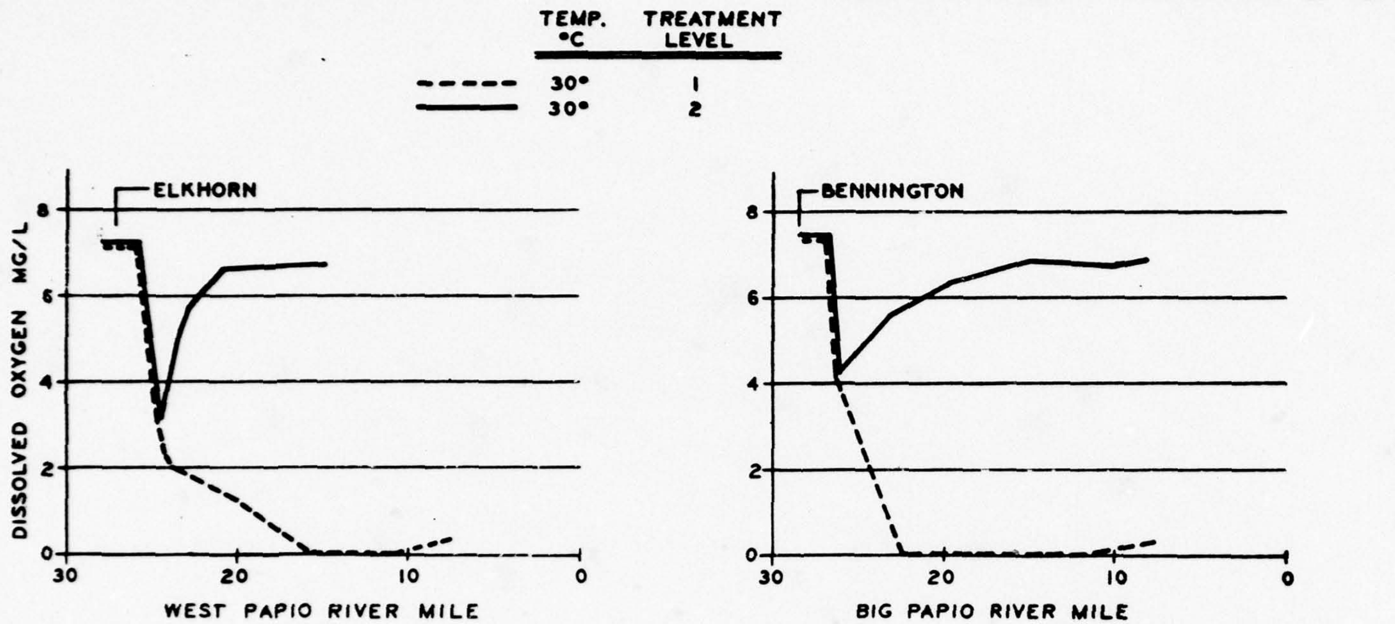


METROPOLITAN OMAHA NEBRASKA
COUNCIL BLUFFS, IOWA
RELATIVE URBAN AREA
WATER QUALITY
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

VOLUME III ANNEX B FIGURE B-4

EFFECT OF ELKHORN WASTEWATER EFFLUENT
LOW FLOW CONDITION-HIGH GROWTH CONCEPT

EFFECT OF BENNINGTON WASTEWATER EFFLUENT
LOW FLOW CONDITION-HIGH GROWTH CONCEPT



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

PAPILLION STREAM MODELING

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

52. The two largest grit facilities, at Leavenworth and Burt-Izard locations, serving a combined area of over 16,000 acres and a population of about 124,000 have caused the greatest operating problems. Six smaller facilities are also subject to intermittent breakdown.

SEWER SYSTEMS - OVERFLOWS

53. Three major combined sewer areas exist in the study area: (1) in Omaha along the Missouri River; (2) in West Omaha along the Little Papillion Creek; and (3) in portions of Council Bluffs along Indian Creek. All three areas contribute to the water quality degradation as indicated in figure B-4.

54. The Omaha-Missouri River combined system alone is estimated to overflow about 50 times a year and contributes about 5 billion gallons of contaminated water to the Missouri River. The effects caused by a 1-year storm are shown in figure B-6.

55. Six major overflow points have been identified in the Little Papillion Creek drainage area. Three overflows go into Little Papillion, two into Cole Creek, and one into Elmwood Park Creek. Three overflows go directly into Little Papillion Creek.

56. These overflows contribute approximately 70 percent of the pollutant load to Little Papillion Creek during storm periods resulting in a high oxygen demand and bacterial contamination to the receiving waters. Approximately 2 billion gallons of overflow occur annually and result in 865 tons of BOD and 2,200 tons of suspended solids being discharged to the Little Papillion Creek and its tributaries.

57. Approximately 1,000 acres in Council Bluffs are served by combined sewers which overflow into Indian Creek. The main overflow is located at the 28th Avenue pump station located south of the residential portion of Council Bluffs. Several other overflow points exist, but these represent rather small flows and most discharge to the Missouri River.

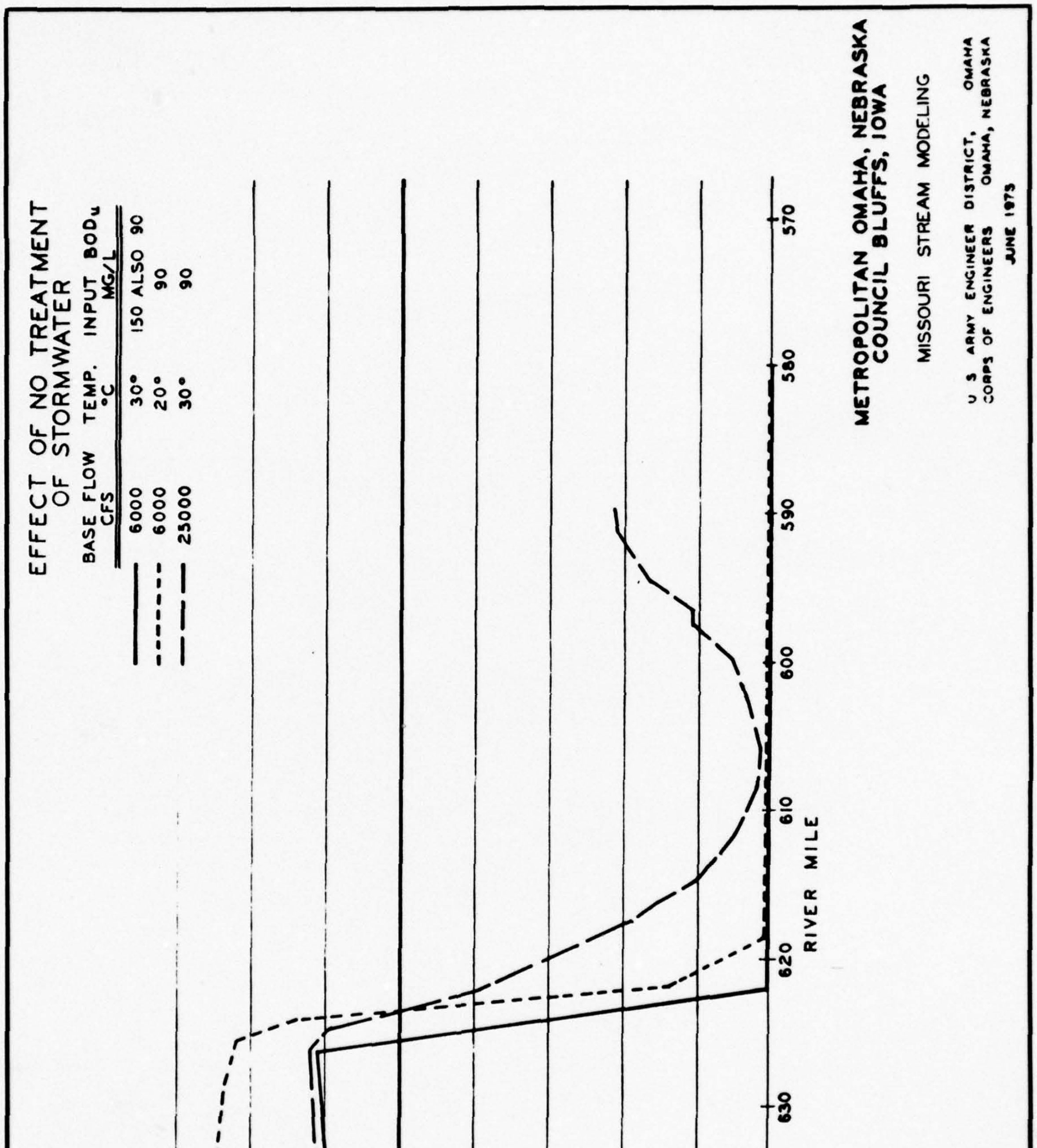
58. Due to the low assimilative capacity of Indian Creek, the 28th Avenue overflow violates State water quality standards and results in an annual discharge of 800-million gallons of wastewaters, 335 tons of BOD, and 840 tons of suspended solids.

59. Neither the state of Iowa nor of Nebraska exempts intermittent discharges, such as combined overflows, from their water quality standards. Also, PL 92-500 states that pollution problems must be corrected regardless of source. Based on water quality modeling for the Missouri River and Papillion Creek, it appears that correction of all combined sewer problems is warranted.

STORMWATER RUNOFF

URBAN STORM RUNOFF

60. Urban storm runoff is a significant source of pollution. This runoff is normally collected by storm sewers and is discharged untreated to lakes and streams. Considerable amounts of solids and bacteria are present in the runoff along with organic material, nutrients, metals, oils, and dissolved salts. The pollutants enter the stream in large quantities during storms and cause shockload conditions.


EFFECT OF NO TREATMENT OF STORMWATER
BASE FLOW CFS
TEMP. °C
INPUT BOD_u MG/L
6000 30° 150 ALSO 90
6000 20° 90
25000 30° 90
DISSOLVED OXYGEN MG/L
RIVER MILE
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
650 640 630 620 610 600 590 580 570
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
MISSOURI STREAM MODELING
U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

61. Based on an analysis of street sweepings in the city of Omaha, concentrations of pollutants in urban storm runoff from residential areas would average approximately 220 mg/l of suspended solids and 23 mg/l of BOD. The impact on the downstream reaches of Papillion Creek from a one-year storm runoff event, which includes the combined sewer overflows, is shown in figure B-7. The water quality impact of a one-year storm discharge from the Papillion Creek on the Missouri River is shown on figure B-8. Reduction of urban storm runoff pollution will be required if State water quality standards are to be maintained. Currently, however, urban storm runoff is overshadowed by agricultural runoff.

<u>AGRICULTURAL STORM RUNOFF</u>

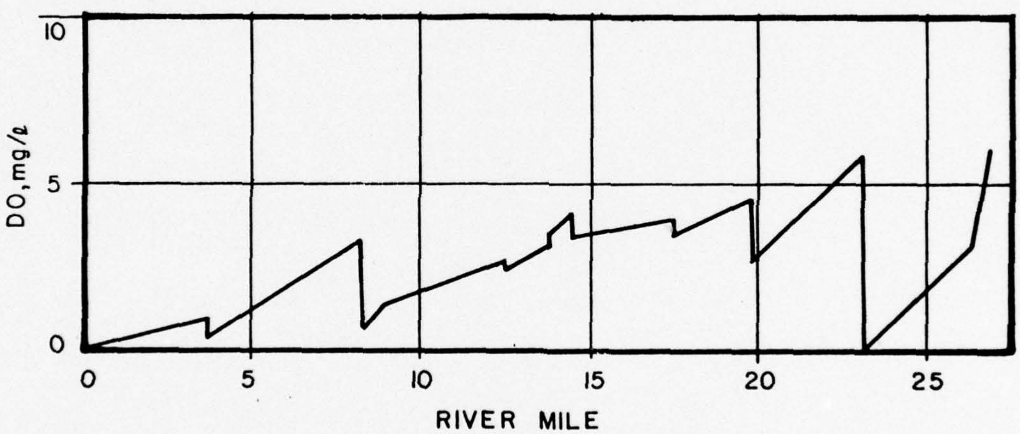
62. A detailed analysis of agricultural pollutants is contained in Annex G of the Supporting Technical Reports Appendix.

63. Any appraisal of the total magnitude of agricultural pollution levels, at least at this time, requires some degree of qualification. Two factors account for this shortcoming; first, the complex and influential interrelationships among various non-point source pollutants make identification of separate causative factors at downstream loading points extremely difficult or vague; and second, the degree or magnitude of any resultant pollution problem varies depending upon the separate viewpoint of any special interest group such as agriculturalists, livestock producers, environmentalists, and others. Basically, the magnitude of most pollutant loadings is related to the runoff of storm water and the use or control of these flows dictates the degree of resultant problems. Individual pollutant loadings, exclusive of feedlot wastes, for the major contributing watersheds within the study area are listed in table B-13.

64. Acceptable soil loss rates for agricultural lands range from 4 to 5 tons per acre per year. Assuming that from 12 to 30 percent of this loss actually finds its way into the receiving streams, a sediment yield from the drainage basin into the receiving stream of about 300 to 1,000 tons per square mile per year would be considered reasonable. All of the sediment yield rates in table B-13 exceed these values, so all watersheds are considered to be classified as excessive contributors of sediment.

65. The ideal level of phosphorous within the water bodies of the area should be such that the phosphorous would be a limiting nutrient to eutrophication. A limiting level has not truly been established; however, some investigations have found that phosphorous levels should be less than 0.02 mg/l. This value was used as the criterion for determining an acceptable yield of phosphorous from a watershed of between 15 to 40 pounds per square mile.

66. Approximately 5 pounds of nitrogen per acre per year enters the soil from the atmosphere. Discounting other losses, such as leaching and crop removal, an erosion loss rate for nitrogen of 5 pounds per acre per year would maintain a balance between the amount lost from the soil and the amount gained from the atmosphere. On this equilibrium basis, the surface erosion of sediments would not be removing nitrogen from the soil or require the addition of supplemental nitrogen to restore the portion lost to erosion. Thus, the acceptable level for erosion removal of nitrogen was established at 5 pounds per acre per year or somewhere between 800 to 1,300 pounds per square mile. Table B-13 indicates existing phosphorous and nitrogen yields on the order of 5 to 30 times acceptable values.



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

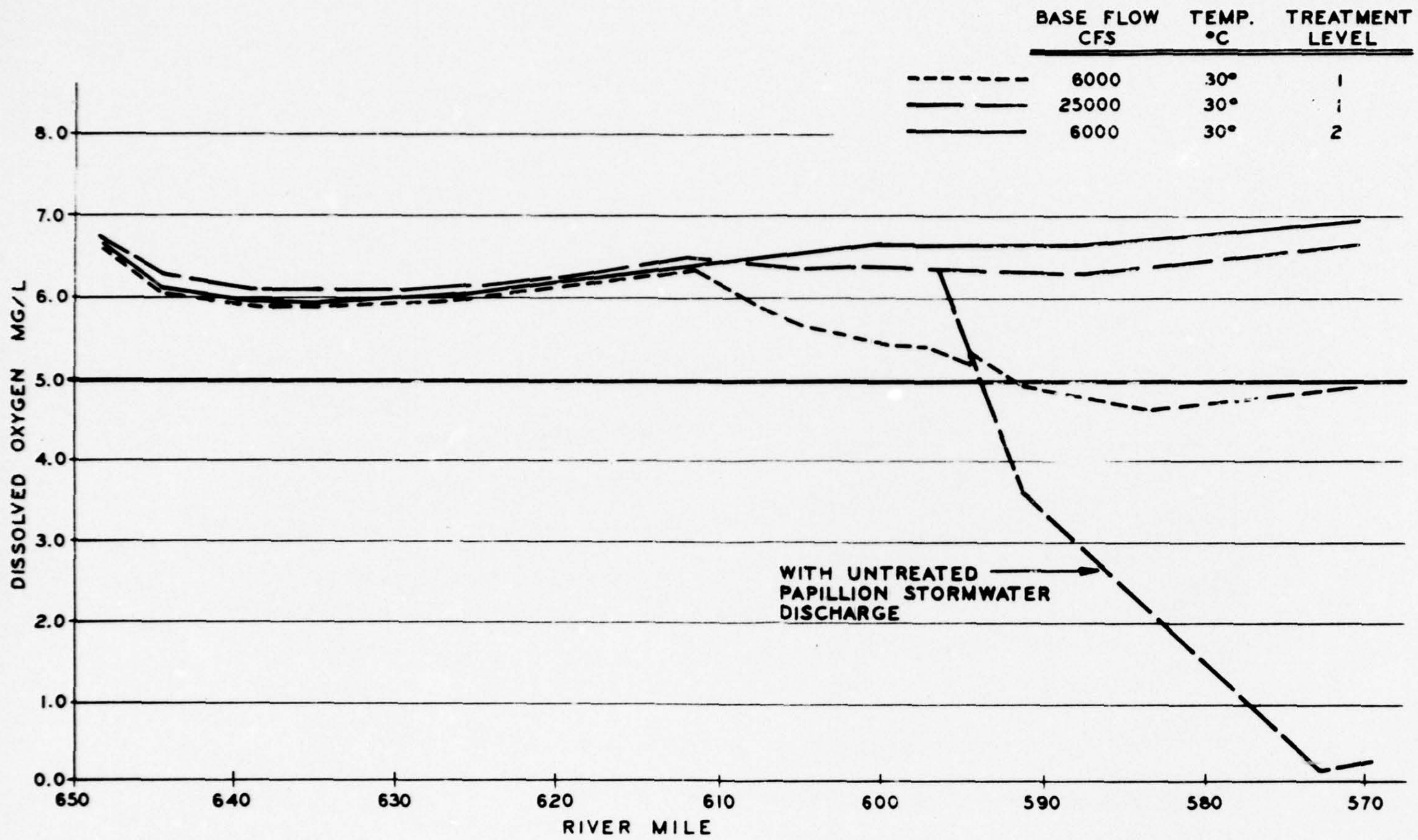
BIG PAPILLION CREEK
RIVER MILES VS.
QUALITY AND FLOW
NO TREATMEMT

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE B-7

EFFECT OF WASTEWATER EFFLUENT



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MISSOURI STREAM MODELING

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

VOLUME III ANNEX B FIGURE B-8

Table B-13
Annual Watershed Pollutant Yield Rates Per Square Mile of Drainage Area

Watershed	Total Rural Drainage (Sq. Mi.)	Sediment (Tons)	Phosphorus (1,000 lbs)	Nitrogen (1,000 lbs)	BOD (1,000 lbs)	COD (1,000 lbs)
Boyer River	1,135	4,160	0.39	10.3	4.1	56.8
Honey Creek	30	4,370	0.50	13.9	5.6	76.6
Pigeon Creek	163	4,190	0.46	12.6	5.0	68.7
Indian Creek	11	5,670	0.47	15.0	6.1	82.7
Mosquito Creek	218	4,120	0.45	12.4	4.9	68.1
Twin Ponies Creek	23.5	4,100	0.44	13.0	5.2	71.7
Keg Creek	139	2,910	0.29	8.8	3.5	48.2
Nishnabotna River	2,870	3,580	0.22	6.5	2.6	36.0
Papillion Creek						
Main Stem	157	3,910	0.46	12.4	5.0	65.3
Little Papillion	24.7	4,000	0.47	12.6	5.1	69.2
West Branch	112	4,030	0.49	12.8	5.1	70.3
Buffalo Creek	23.6	3,600	0.46	11.6	4.6	64.0
Springfield Creek	15.2	3,970	0.51	13.3	5.4	73.4

67. The analysis base for an acceptable level of BOD and COD was based on the effluent quality of an advanced waste treatment system. Using an assumed effluent quality of 4 mg/l BOD and 15 mg/l COD, the equivalent loss rate from agricultural practices would be 3,000 and 10,000 pounds per square mile per year for BOD and COD, respectively. These loss determinations are based on an average value for the study area of 1,000 pounds per square mile per year as being approximately equivalent to an average concentration of 1.5 mg/l. Corresponding yield rates, based on delivery ratios of .14 to .35, would range from 400 to 1,000 pounds per square mile for BOD and 1,400 to 3,500 pounds per square mile for COD. Again, from table B-13, it can be seen that all of the watersheds within the study area would be considered as excessive contributors of BOD and COD. It is probable, however, that both would be reduced to acceptable levels with proper soil management practices for control of sediment.

68. The major pollutants in feedlot runoff are the high oxygen-demanding organic material, nitrogen, phosphorous, color, taste, odor, and micro-organisms, both bacterial and viral. The general quality of feedlot runoff is summarized in table B-14. It has been reported that half of the BOD and COD are generated by soluble organic material. This is indicative of the high loadings after equalization, sedimentation, and retention of the wastes. These values are also included in table B-14. The strength of the wastes, as well as the time of concentration of the wastes, in the runoff water depend on antecedent conditions and the intensity of precipitation. Average concentrations were used in the report.

Table B-14
Quality of Feedlot Runoff

Parameter	Measured Concentration Range During Runoff		After Retention (all mg/l)
	Winter	Summer	
pH	6.7-7.6	6.6-9.4	-
BOD_5	14,000-78,000	1,300-8,200	200-800
COD mg/l		1,900-7,800	2,000-3,900
Total Solids, %	3-11.5	1.0-3.4	4,000-7,900
Total Vol. Solids, %	3-19.8	0.24-1.74	2,000-3,500
Suspended Solids, mg/l	-	1,100-13,500	600-1,800
Organic N	-	-	115-230
NH_3-N, mg/l	670-2,000	25-80	30-40
NO_3-N, mg/l	0-80	0-17	-
Total N, mg/l	1,400-5,800	65-550	145-270
P, mg/l	7-750	14-47	-
Cl, mg/l	-	200-415	-

Source: Mcgee, T. J. and Christensen, L. R., "Laboratory Studies on Feedlot Runoff", presented at 23rd Annual Sanitary Engineering Conference, Kansas University, Lawrence, Kansas, Feb. 7, 1973.

69. Estimated annual runoff loss of pollutants from feedlots in the study area are shown in table B-15. It is important to emphasize that the estimated losses obtained in this analysis are the loadings coming directly off the feedlot and not the loadings measurable at some point downstream. The loadings in table B-15 represent approximately 10 percent of the total wastes generated in the feedlot. The values measured downstream will be less because of losses occurring both from sedimentation of the suspended material and from decay, absorption, volatilization, and infiltration of the dissolved constituents. Available literature indicates that from 20 to 25 percent of the table B-15 figures actually reach the stream. The above assumptions correspond well to figures used by the Nebraska Natural Resource Commission in estimating that 2 percent of the total waste generated by the feed animals eventually reaches the stream on a basin-wide average basis.

TABLE B-15

QUALITY OF FEEDLOT RUNOFF

Parameter	Measured Concentration Range During Runoff Winter	Summer	After Retention (all mg/l)
pH	6.7-7.6	6.6-9.4	-
BOD_5, mg/l	14,000-78,000	1,300-8,200	200-800
COD, mg/l		1,900-7,800	2,000-3,900
Total Solids, %	3-11.5%	1.0-3.4	4,000-7,900
Total Vol. Solids, %	3-19.8%	0.24-1.74	2,000-3,500
Suspended Solids, mg/l	-	1,100-13,500	600-1,800
Organic N	-	-	115-230
NH_3-N, mg/l	670-2,000	25-80	30-40
$NO-_3$-N, mg/l	0-80	0-17	-
Total N, mg/l	1,400-5,800	65-550	145-270
P, mg/l	7-750	14-47	-
Cl-, ,g/l		200-415	-

Source: Mcgee and Christensen, reference 27.

SECTION C

WASTEWATER MANAGEMENT GOALS AND OBJECTIVES

WASTEWATER MANAGEMENT GOALS AND OBJECTIVES

TABLE OF CONTENTS

SECTION C

WASTEWATER MANAGEMENT GOALS AND OBJECTIVES

Goals

1. The main goal of the wastewater management study is to aid area officials and planners as they work to solve the wastewater problems of the next 50 years. It is hoped that this study will provide a strong base in which to plan local water pollution abatement projects in the future.

2. A major goal, which must be met by this study, is compliance with the Water Pollution Control Act Amendments of 1972 (PL 92-500). The Act states that:

It is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985.

It is the national goal that, wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in or on the water be achieved by 1 July 1983.

Objectives

3. The following are the regional planning objectives of the alternative plans developed for the wastewater management portion of the Omaha-Council Bluffs study:

- Provide secondary treatment at all publicly-owned sewage treatment works in the study area by 1977.

- Provide for "best practicable waste treatment technology" at all publicly-owned sewage treatment works in the study area by 1983.

- Provide treatment of combined sewer overflows in the Omaha-Missouri River, Little Papillion Creek, and Indian Creek drainage areas sufficient to meet water quality standards.

- Provide for a reduction in urban and agricultural runoff sufficient to meet State water quality standards.

- Provide sewer systems with sufficient reliability to insure that all dry-weather flows will be conveyed to the sewage treatment plants.

- Provide for "zero discharge of pollutants" by 1985.

- Provide an analysis of the required legal, financial, and institutional arrangements to implement the plans.

4. The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and the Urban Studies Policies and Procedures were used as guidance in developing alternative plans to meet the objectives.

SECTION D

WASTEWATER MANAGEMENT PLANNING CRITERIA

WASTEWATER MANAGEMENT PLANNING CRITERIA

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LIST OF TABLES (Cont'd)

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SECTION D

WASTEWATER MANAGEMENT

PLANNING CRITERIA

Population and Land Use

1. Sec. 208 of PL 92-500 requires that land use/water quality/ public involvement be integrated in wastewater management planning. Five questions are asked with regard to land use:

- Is this the optimum development pattern for water quality?

- Could the number and magnitude of wastewater discharges be reduced if the development pattern was changed?

- Will the location of discharges have an adverse impact on water quality?

- Will the timing of discharges have an adverse impact on water quality?

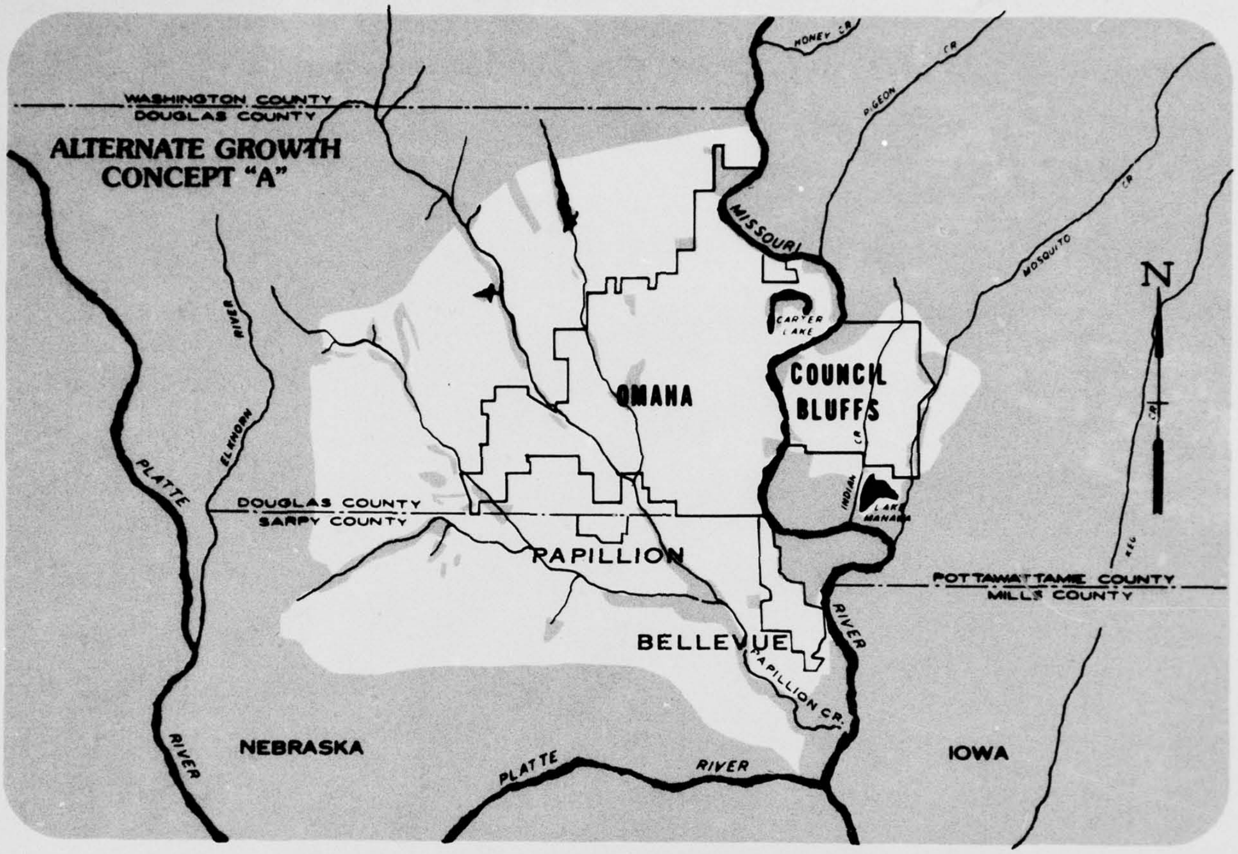
- Would the implementation of additional land use controls reduce overall investments?

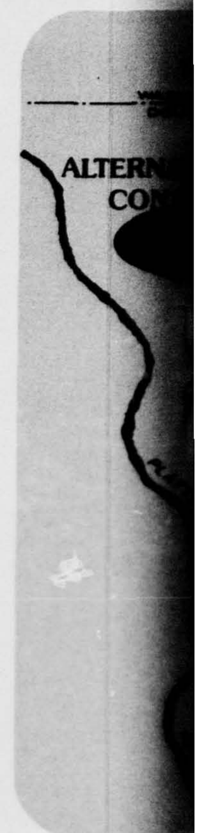
2. Serious consideration is to be given to the public's attitudes with regard to urban growth. Recognition is given to the relationships between sewer implementation and the growth of a community.

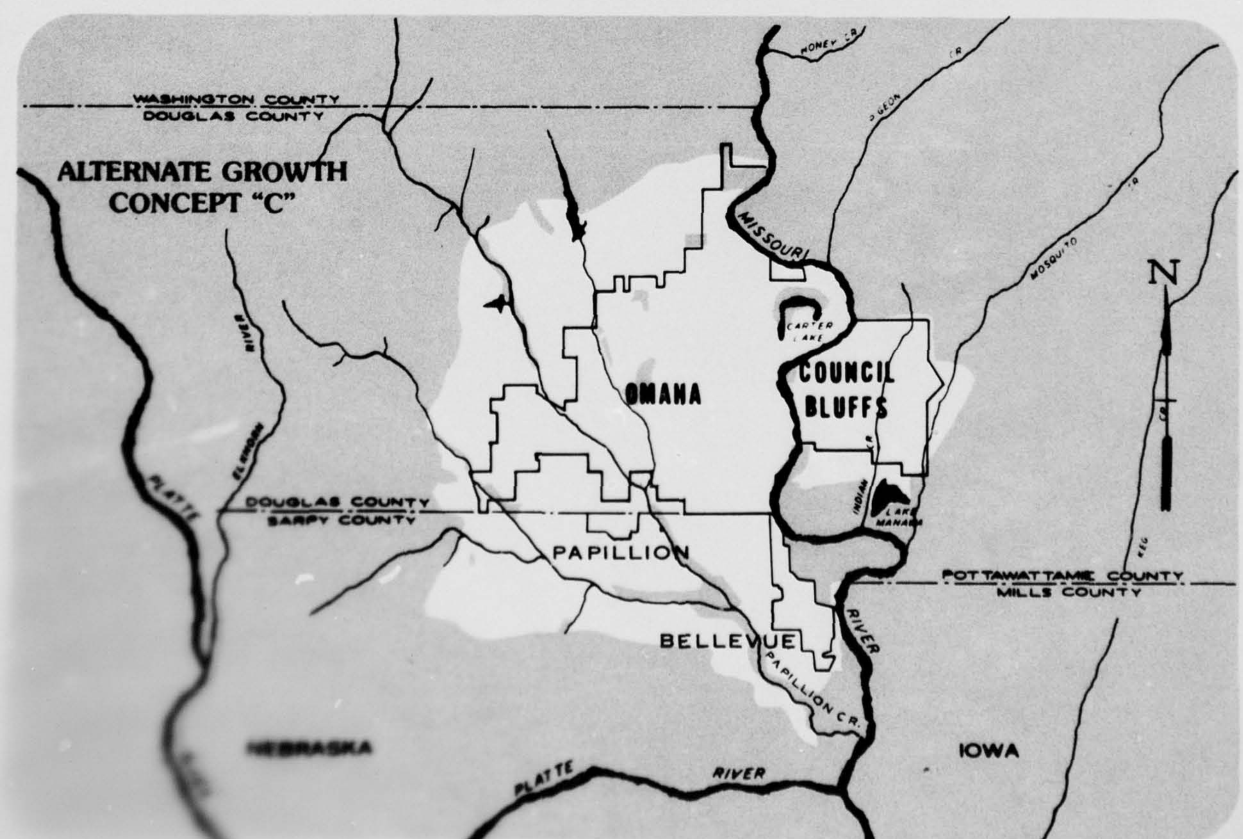
3. In the case of the Omaha, Nebraska-Council Bluffs, Iowa urban area, no general consensus could be arrived at for a future growth pattern. In its analysis of the growth, the Corps of Engineers has examined input from various other planning agencies in the study area and has used not one but four alternative growth patterns for future urban growth in the metropolitan area.

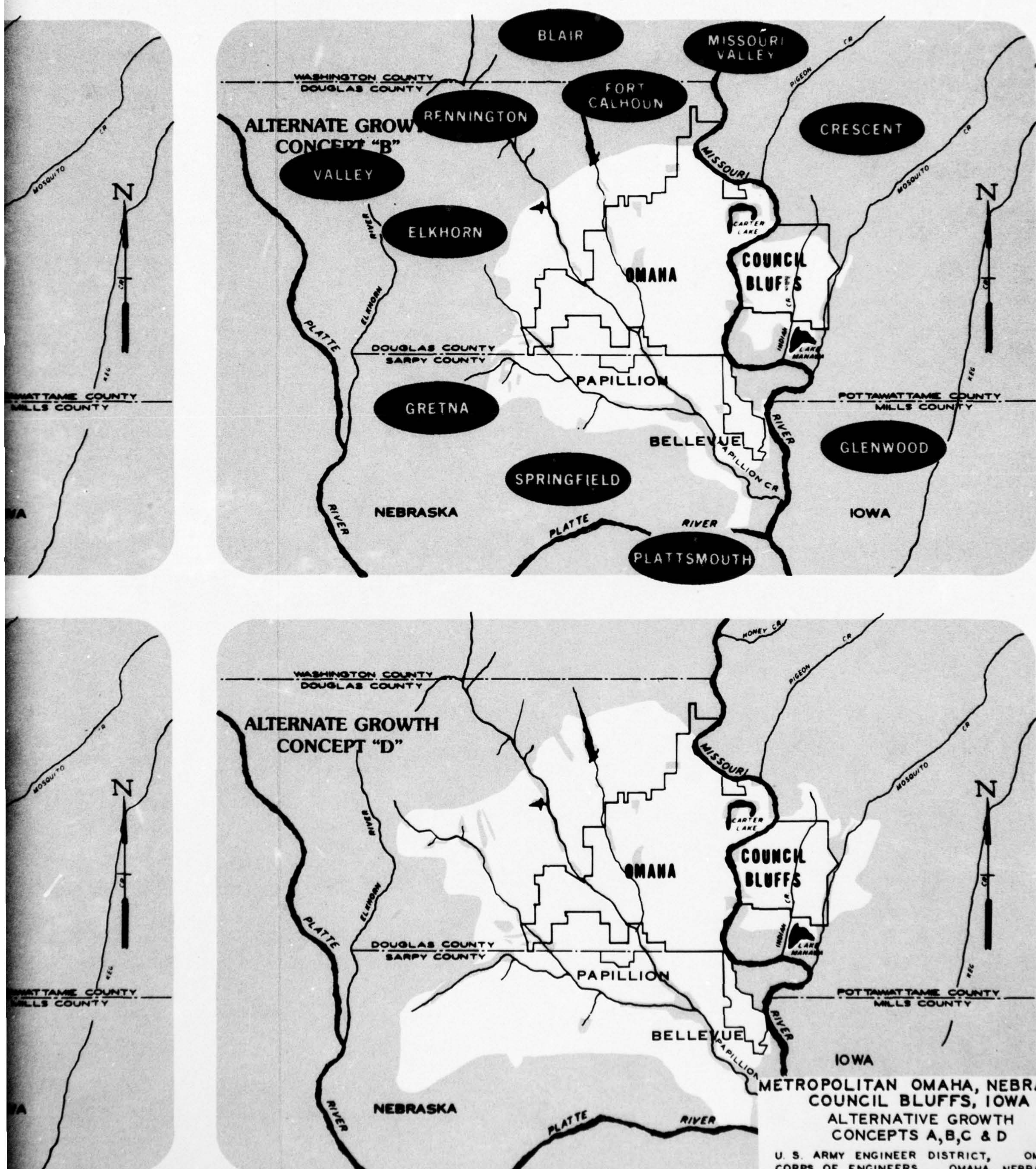
4. A set of four possible patterns of urban growth exists for the area (Concepts A, B, C, and D). Concept A assumes a continuation of present land use and represents low density urban sprawl. Concept B involves a higher density growth consisting of controlled growth for urban Omaha with separate, self-sustaining satellite cities separated from urban Omaha by open space. Concept C also envisions a high density pattern for Omaha, but with expanding boundaries rather than separate satellite cities. Concept D assumes low density development, as in Concept A, but presumes the development will occur as a secondary effect of the existing transportation routes.

5. Figure D-1 illustrates the four growth concepts. A more detailed discussion of the growth concepts is contained in the Alternative Future Plan Formulation Annex. Alternative futures permit determination of water resource system sensitivity to changing growth policies, permit an analysis of the role of water resource systems in shaping urban growth, provide an effective tool for


ALTERNATE GROWTH CONCEPT "A"
WASHINGTON COUNTY
DOUGLAS COUNTY
DOUGLAS COUNTY
SARPY COUNTY
POTTAWATTAMIE COUNTY
MILLS COUNTY
OMAHA
COUNCIL BLUFFS
PAPILLION
BELLEVUE
CARTER LAKE
LAKE MANAWA
MISSOURI
RIVER
PLATTE RIVER
ELKHORN
PAPILLION CR.
MOSQUITO CR.
PIGEON CR.
INDIAN CR.
NEBRASKA
IOWA
N




ALTERNATE GROWTH CONCEPT "C"
WASHINGTON COUNTY
DOUGLAS COUNTY
DOUGLAS COUNTY
SARPY COUNTY
POTTAWATTAMIE COUNTY
MILLS COUNTY
OMAHA
COUNCIL BLUFFS
PAPILLION
BELLEVUE
CARTER LAKE
LAKE MANAWA
MISSOURI
RIVER
PLATTE RIVER
ELKHORN
PAPILLION CR.
MOSQUITO CR.
INDIAN
NEBRASKA
IOWA
N



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
ALTERNATIVE GROWTH
CONCEPTS A, B, C & D

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE D-1

citizen communication concerning water and related land resource management, provide opportunities for multiple-objective planning, and allow the Corps of Engineers to assume a non-advocacy position with regard to land use.

6. Table D-1 contains existing and future population projections by county for the four growth concepts. The 1995 projections for the three-county SMSA (Douglas, Sarpy, and Pottawattamie Counties) were then adopted by the Metropolitan Area Planning Agency Council of Elected Officials for use in their 1995 transportation study. The SMSA projection resembles OBERS Series "C" as modified locally. Projections for the other counties were obtained from State or local projections with the exception of Growth Concept B where urban population growth was dispersed to rural counties. The year 2020 projections were based on analysis of 13 different population projections. The selected 2020 projections approximate OBERS Series "C".

7. Table D-2 shows the breakdown of population by major urban, minor urban, and non-urban sanitary districts according to the four growth concepts. Population totals differ from table D-1 due to rural non-community populations served by individual septic systems.

Table D-1
1970 Population With Future Projections For Seven-County Area

County	1970 Census Data	1995 Growth Concepts A	1995 Growth Concepts B	1995 Growth Concepts C	1995 Growth Concepts D	2020 Growth Concepts A	2020 Growth Concepts B	2020 Growth Concepts C	2020 Growth Concepts D
Nebraska									
Cass	18,076	20,562	32,879	20,562	20,562	21,526	33,491	21,526	21,526
Douglas	389,455	533,378	515,791	581,667	523,502	650,241	634,989	686,483	619,346
Sarpy	66,200	215,442	176,800	167,113	225,278	260,743	220,200	228,501	288,193
Washington	13,310	17,759	42,063	17,759	17,759	19,348	52,242	19,348	19,348
Nebraska Total	487,041	787,141	767,533	787,101	787,101	951,858	940,922	955,858	948,413
Iowa									
Harrison	16,220	16,834	22,904	16,834	16,834	17,727	23,386	17,727	17,727
Mills	12,517	11,961	24,939	11,961	11,961	11,418	24,795	11,418	11,418
Pottawattamie	86,991	102,074	102,624	102,104	102,104	123,497	115,397	119,497	126,942
Iowa Total	115,728	130,869	150,467	130,899	130,899	152,642	163,578	148,692	156,087
7 County Total	602,769	918,000	918,000	918,000	918,000	1,104,500	1,104,500	1,104,500	1,104,500

Table D-2

Projected Populations (By Growth Concepts) For Sanitary Districts in Study Area

Sanitary District	1995 Population Concept A	Concept B	Concept C	Concept D	2020 Population Concept A	Concept B	Concept C	Concept D
Major Urban								
Missouri River	179,897	201,569	221,075	192,917	209,586	255,498	274,675	209,308
Council Bluffs	73,420	74,681	74,111	65,385	89,353	84,749	89,532	91,113
Papillion	514,377	376,274	472,508	511,356	610,106	424,742	544,838	609,588
All Minor Urban	57,589	172,759	57,589	55,625	70,703	214,759	70,703	69,739
All Non-Urban	26,999	26,999	26,999	26,999	29,304	29,304	29,304	29,304
Totals	852,282	852,282	852,282	852,282	1,009,052	1,009,052	1,009,052	1,009,052

Projected Pollutant Loads

8. The annual pollutant loads emanate from two major sources, municipal (domestic and industrial) wastewater and stormwater run-off.

9. Population projections for individual communities are given in Annex A. These projections were used to determine projected flows for individual sewage treatment plants. The flow projections are indicated in tables D-3 through D-5.

10. Tables D-6 through D-8 present the estimated wastewater quality characteristics. Multiplication of the flow and constituent values for a given location will give the design loading for that sewage treatment plant.

11. Table D-9 presents the projected mean annual stormwater quantities and loads that will occur in the seven-county study area.

Table D-3
Average Daily Flow Projections for the Major Urban Treatment Plants
(MGD)

Treatment Plant	Waste Source	1995 Concept A	1995 Concept B	1995 Concept C	1995 Concept D	2020 Concept A	2020 Concept B	2020 Concept C	2020 Concept D
Missouri River	Domestic	18.7	21.0	23.0	20.1	23.1	28.1	30.2	23.0
	Industrial	28.3	22.3	28.3	28.3	37.3	32.1	37.3	37.3
	Total	47.0	43.3	51.3	48.4	60.4	60.2	67.5	60.3
Papillion Creek	Domestic	54.6	40.0	50.2	54.1	68.2	47.8	60.9	68.0
	Industrial	6.6	5.2	6.6	6.6	29.8	25.6	29.8	29.8
	Total	61.2	45.2	56.8	60.7	98.0	73.4	90.7	97.8
Mosquito Creek	Domestic	7.6	7.8	7.7	6.8	9.8	9.3	9.8	10.0
	Industrial	8.8	6.9	8.8	8.8	20.1	17.3	20.1	20.1
	Total	16.4	14.7	16.5	15.6	29.9	26.6	29.9	30.1

Table D-4

PROJECTED AVERAGE DAILY WASTEWATER FLOWS (MGD)

FOR MINOR URBAN WASTEWATER TREATMENT PLANTS

	1995											
	Concept A			Concept B			Concept C			Concept D		
Treatment Plant	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.
Bennington	.24	.09	.33	1.56	1.22	2.78	.24	.09	.33	.24	.09	.33
Elkhorn	.29	.1	.39	1.56	1.22	2.78	.29	.1	.39	.29	.1	.39
Valley	.27	.21	.48	.52	.41	.93	.27	.21	.48	.27	.21	.48
Boystown	.17	0	.17	.2	0	.2	.23	0	.23	.17	0	.17
Springfield	.35	.07	.42	2.08	1.63	3.71	.35	.07	.42	.35	.07	.42
Gretna	.75	.34	1.09	2.6	2.03	4.63	.75	.34	1.09	.75	.34	1.09
Bellevue	1.32	0	1.32	1.12	0	1.12	1.32	0	1.32	1.12	0	1.12
Deer Creek	0	0	0	.52	0	.52	0	0	0	0	0	0
Blair	.97	.76	1.73	2.5	1.95	4.45	.97	.76	1.73	.97	.76	1.73
Fort Calhoun	.14	.11	.25	.62	.49	1.11	.14	.11	.25	.14	.11	.25
Plattsmouth	.8	.62	1.42	2.08	1.63	3.71	.8	.62	1.42	.8	.62	1.42
Missouri Valley	.41	.32	.73	1.04	.81	1.85	.41	.32	.73	.41	.32	.73
Glenwood	.42	.33	.75	1.04	.81	1.85	.42	.33	.75	.42	.33	.75
East Bellevue	0	0	0	.73	0	.73	0	0	0	0	0	0
Total Flows	6.13	2.95	9.08	18.17	12.2	30.37	6.19	2.95	9.14	5.93	2.95	8.88

	2020											
	Concept A			Concept B			Concept C			Concept D		
Treatment Plant	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.	Dom.	Ind.	Tot.
Bennington	.35	.12	.47	2.48	1.83	4.31	.35	.12	.47	.35	.12	.47
Elkhorn	.42	.2	.62	2.48	1.83	4.31	.42	.2	.62	.42	.2	.62
Valley	.37	.27	.64	.66	.49	1.15	.37	.27	.64	.37	.27	.64
Boystown	.32	0	.32	.24	0	.24	.39	0	.39	.32	0	.32
Springfield	.7	.15	.85	2.75	2.03	4.78	.7	.15	.85	.7	.15	.85
Gretna	1.45	.28	1.73	3.85	2.84	6.69	1.45	.28	1.73	1.45	.28	1.73
Bellevue	1.32	0	1.32	1.29	0	1.29	1.32	0	1.32	1.29	0	1.29
Deer Creek	0	0	0	.77	0	.77	0	0	0	0	0	0
Blair	1.14	.84	1.98	3.3	2.44	5.74	1.14	.84	1.98	1.14	.84	1.98
Fort Calhoun	.19	.14	.33	.88	.65	1.53	.19	.14	.33	.19	.14	.33
Plattsmouth	.88	.65	1.53	2.2	1.63	3.83	.88	.65	1.53	.88	.65	1.53
Missouri Valley	.48	.35	.83	1.1	.81	1.91	.48	.35	.83	.48	.35	.83
Glenwood	.4	.29	.69	1.1	.81	1.91	.4	.29	.69	.4	.29	.69
East Bellevue	0	0	0	.77	0	.77	0	0	0	0	0	0
Total Flows	8.02	3.29	11.31	23.87	15.36	39.23	8.09	3.29	11.38	7.99	3.29	11.28

Dom. - Domestic
Ind. - Industrial
Tot. - Total

Table D-5
Average Daily Domestic Flow Projections For
Non-Urban Wastewater Treatment Plants
(MGD)

Treatment Plant	1975 (1)	1995 (2)	2020 (3)
Nebraska			
Arlington	.086	.140	.159
Herman	.030	.032	.031
Kennard	.032	.035	.034
Weeping Water	.107	.143	.159
Union	.026	.025	.025
Nehawka	.028	.040	.049
Murray	.027	.034	.036
Murdock	.025	.033	.036
Manley	.014	.019	.021
Louisville	.097	.093	.089
Greenwood	.048	.090	.121
Elmwood	.052	.079	.099
Eagle	.041	.081	.108
Avoca	.022	.028	.031
Alvo	.014	.014	.014
Waterloo	.043	.057	.090
Iowa			
Logan	.143	.185	.203
Woodbine	.127	.177	.203
Mondamin	.039	.041	.035
Dunlap	.121	.154	.166
Pisgah	.074	.032	.034
Avoca	.144	.151	.153
Carson	.071	.094	.100
Hancock	.021	.028	.031
Macedonia	.031	.045	.052
Minden	.041	.055	.059
Neola	.091	.125	.153
Oakland	.151	.189	.227
Treynor	.044	.140	.212
Underwood	.040	.085	.113
Walnut	.082	.085	.085
Emerson	.045	.060	.068
Malvern	.109	.107	.099
Tabor	.090	.111	.129
Total	2.156	2.807	3.224

(1) Based on 94 gpcd.
(2) Based on 104 gpcd.
(3) Based on 110 gpcd.

Table D-6
Major Urban Plants - Flow and Quality Characteristics

Design Quality	Papillion Creek Plant	Missouri River Plant: North Sewer	Missouri River Plant: South Sewer	Council Bluffs-Mosquito Creek Plant
Residential and Industrial - mg/l				
SS	450	505	590	600
VSS	380	430	505	500
BOD_5	420	485	570	580
COD	760	880	1,035	1,050
TKN	44	50	57	60
PO_4-P	9	8	7	8.5
ALK ($CaCO_3$)	225	225	225	225
Oil and Grease	110	180	260	245
Water Plant Sludge				
#/day per mgd	2,700 (3)	3,100 (2)	-	4,050
Design Flows				
1975 - mgd	25	36		8.4
1995 - Range, mgd	44-110	43-51		15-16
2020 - Range, mgd	72-160	60 (1)		27-30

(1) 2020 Flow Distribution: North Sewer = 41 mgd, South Sewer = 19 mgd.
(2) From Florence Water Supply.
(3) From Platte Water Supply.

Table D-7
Minor Urban Plant Summary

Present Conditions	
Number of plants	12
Flow (mgd)	
Median	0.27
Range	0.06 to 0.88
Treatment Technology	
Act. Sl. and Modifications	3
Trick. Fil. and Modifications	4
Stabilization Ponds	2
Primary and Equiv.	3
Future Conditions	
1995	
Number of plants	11*
Flow (mgd)	
Median	1.1
Range	0.15 to 4.6
2020	
Flow (mgd)	
Median	1.5
Range	0.28 to 6.7
Influent Quality (mg/l)	
SS	260
VSS	200
BOD_5	230
COD	450
TKN	35
PO_4-P	8.5
ALK ($CaCO_3$)	225
Special	
Water Plant Wastes	
Blair	7,800 #/Day
Bellevue	MG
Oil and Grease	
Elkhorn	156 mg/l at 0.15 mgd = 195 lbs/day

* 13 under Growth Concept B

Table D-8
Non-Urban Plant Summary

Present Conditions	Municipal	Private and/or Specialized Public Interest	
Number of plants	34	52	
Flow (mgd)			
Median	0.06	0.08	
Range	0.014-0.15	0.008-26.0	
Treatment Technology		Present	(After 1985)
Act. Sl. and Modifications	7	17	7
Trick. Fil. and Modifications	3	8	2
Stabilization Ponds	20	26	13
Primary and Equivalent	3	3	0
None	1	0	0

Future Conditions	Municipal	Private and/or Specialized Public Interest
1995		
Number of plants	34	22
Flow (mgd)		
Median	0.08	0.025
Range	0.014-0.19	0.10-0.050
2020		
Flow (mgd)		
Median	0.09	0.025
Range	0.014-0.23	0.10-0.050

Influent Quality (mg/l)	
SS	330
VSS	260
BOD_5	270
COD	530
TKN	41
PO_4-P	10.0
ALK ($CaCO_3$)	225

Table D-9
Mean Annual Stormwater Quantities and Loads

	Present	2020 Growth Concepts A	B	C	D
Urban					
Flow (MG/yr)	17,000	36,000	30,000	30,000	36,000
SS (tons/yr)	26,000	56,000	51,000	50,000	57,000
BOD (tons/yr)	3,100	4,900	4,600	4,700	5,100
P (tons/yr)	100	150	130	140	150
N (tons/yr)	310	520	450	460	520
Rural*					
Flow (MG/yr)	26,000	17,000	22,000	21,000	18,000
SS (tons/yr)	1,800,000	250,000	320,000	320,000	270,000
BOD (tons/yr)	2,000	180	230	220	190
P (tons/yr)	120	12	15	15	13
N (tons/yr)	2,900	400	520	500	420
Total					
Flow (MG/yr)	43,000	53,000	52,000	51,000	54,000
SS (tons/yr)	1,826,000	306,000	371,000	370,000	327,000
BOD (tons/yr)	5,100	5,080	4,830	4,920	5,290
P (tons/yr)	220	162	145	155	163
N (tons/yr)	3,210	920	970	960	940

* Rural load decreases considerably by 1985 because it is assumed that runoff from feedlots will go to zero by 1980 and good cropland management practice will reduce cropland runoff.

Water Quality Criteria

12. The States of Nebraska and Iowa have water quality standards for their streams. Both states have non-degradation clauses which state that the quality of the water shall not be degraded below these criteria. The criteria vary, depending on the intended uses of the receiving water. Water quality criteria, relative to recreation, are outlined in the regional water supply report in the Supporting Technical Reports Appendix.

Effluent Criteria

13. Three effluent standards for wastewater treatment system discharges were established by PL 92-500, the Federal Water Pollution Control Act Amendments of 1972. The lowest level, Level 1, is secondary treatment and is fixed by EPA definition. Level 1 treatment is required by 1977. The next level, Level 2, is referred to as Best Practicable Waste Treatment Technology (BPWTT) - Water Quality and is required by 1983. This level of treatment is based either on the State water quality standards or an interpretation of best practicable technology. Under the water quality interpretation, Level 2 treatment, the effluent levels will depend on the size and assimilative capacity of the area streams. Level 3 treatment is the highest level of treatment and is based on matching

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the background quality of the Missouri River, and approximates the Corps of Engineers' interpretation of zero discharge under PL 92-500. This "zero discharge" level is a national goal by 1985. The effluent standards for these three levels of treatment are shown in table D-10.

14. Three effluent standards have also been established for urban stormwater runoff discharges and are shown in table D-11. Level 1 was established to provide a minimal degree of treatment by providing screening, sedimentation, and disinfection. Level 2 was established to provide additional treatment, which might be necessary to protect water quality. Level 3 was established to provide the basic design and cost of a high degree of treatment for potential use as a public or industrial water supply source.

Treatment Technology

15. Three wastewater treatment technologies were considered; (1) conventional biological, (2) physical-chemical, and (3) land treatment.

16. Physical-chemical was not adopted for a full treatment alternative for the following reasons:

- The organic nature of the wastewater makes it treatable by a biological treatment process, at lower unit cost per pound of COD removed.

Table D-10
Summary of Effluent Standards for Wastewater Treatment Goals

Treatment Goal	Level	BOD	SS	NH_3-N	Org N	NO_2 & NO_3 as N	T Phos	Fecal Coliform	pH
Wastewater Treatment									
Secondary	1	30	30	20	20	NA	10	200/100ml	6-9
BPWTT-Water Quality	2	<15	<15	0.5	2.0	<30	<2.0	200/100ml	6-9
Zero Discharge	3	5	5	0.5	2.0	4	0.1	200/100ml	6-9

NA - Not applicable.

Table D-11

Summary of Effluent Standards for Stormwater Treatment Goals

Stormwater Treatment	
Level 1	Screening, sedimentation, disinfection. Estimated 40% removal BOD; 70% removal SS; to 200/100 ml fecal coliforms. Full alternate.
Level 2	Screening, sedimentation, micro-screening, disinfection. Estimated 67% removal BOD; 90% removal SS; to 200/100 ml fecal coliforms. Full alternate.
Level 3	Treatment required for re-use as public or industrial water supply source. Not a full alternate. Generalized designs and costs only.

- Current planning, design, and construction have been based on biological treatment systems, and existing systems would require major changes to adopt a physical-chemical treatment process.

- The scope of the Urban Study does not direct itself to the detailed design and cost considerations necessary for full evaluation of physical-chemical treatment at each plant in the study area. In particular cases, this question should be reviewed during the facilities planning process.

17. Land treatment was also a process technology used in developing wastewater management plans for the Urban Study. This treatment process would provide treatment equivalent to Level 3 treatment, but was considered to be used in the other two levels of treatment even though the effluent quality meets Level 3 criteria. Land areas suitable for land treatment of wastewater have been located within a 100-mile radius of the urban area. Consequently, land treatment is a viable alternative for the wastewater management study.

Stormwater Management

TREATMENT PROCESSES

18. The treatment of urban stormwater runoff presents peculiar design considerations which are created by the high variability experienced in both influent volumes and pollutant concentrations.

Process considerations for such facilities should, therefore, include hydraulic surge control and storage to reduce the instantaneous maximum hydraulic rates and to equalize the pollutant concentrations.

19. Basically, two treatment techniques have been developed, each capable of satisfying the stormwater treatment goals. The first technique, Upsystem Storage and Treatment, employs independent stormwater treatment facilities for a particular drainage area or group of drainage areas. The effluent from these facilities is discharged directly to the particular receiving stream. The second technique, treatment at the Municipal Plant, includes collection and storage of urban stormwater runoff with regulated discharge to an existing or proposed interceptor and treatment of the combined flow at the municipal wastewater plant.

UPSYSTEM STORAGE AND TREATMENT

20. The Upsystem Storage and Treatment of urban stormwater runoff has been developed and designed to satisfy the lower two levels of stormwater treatment desired. Figure D-2 illustrates these two systems. Level 1 includes screening, sedimentation with a two-hour minimum detention, and disinfection. This system will generally achieve a 70 percent reduction of suspended solids and 40 percent reduction in biochemical oxygen demand. Level 2 includes screening, sedimentation with a two-hour minimum detention, microstraining, and disinfection. This system will generally achieve a 90 percent and 67 percent reduction in suspended solids and BOD, respectively.

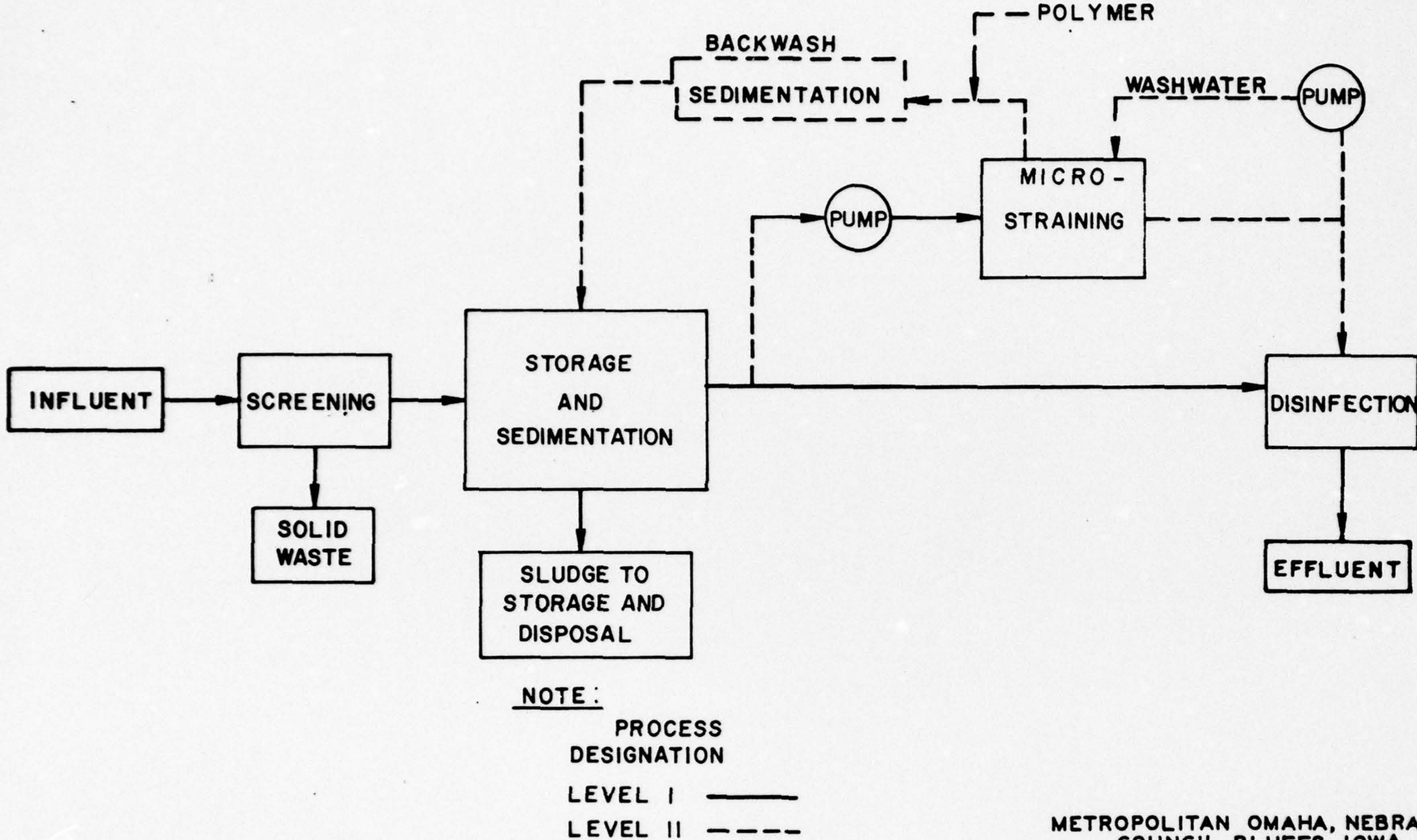
21. The use of both earth and concrete storage basins for upsystem storage has been required for two reasons. One, earth storage is much less expensive than concrete storage, but because earth basins require larger amounts of land area, concrete basins are used in presently urbanized areas where available land is at a premium. Secondly, for aesthetics and odor control, it is desirable to provide covered concrete storage in presently urbanized areas. Where land is available in the developing suburban areas, adequate buffer zones can be provided to improve the desirability of earth storage for stormwater treatment facilities.

22. When earth basins are employed for storage and sedimentation, concrete chlorine contact tanks, designed for a minimum 15 minute detention, were used with adequate baffling and complete mixing included for positive disinfection.

<u>TREATMENT AT THE MUNICIPAL PLANT</u>

23. The treatment of urban stormwater runoff at the municipal plant was developed with the intent of providing the flexibility of a high level of stormwater treatment at the municipal plant. It was also anticipated that this technique would have considerable merit if high levels of treatment would be required to satisfy water-quality standards on receiving streams.

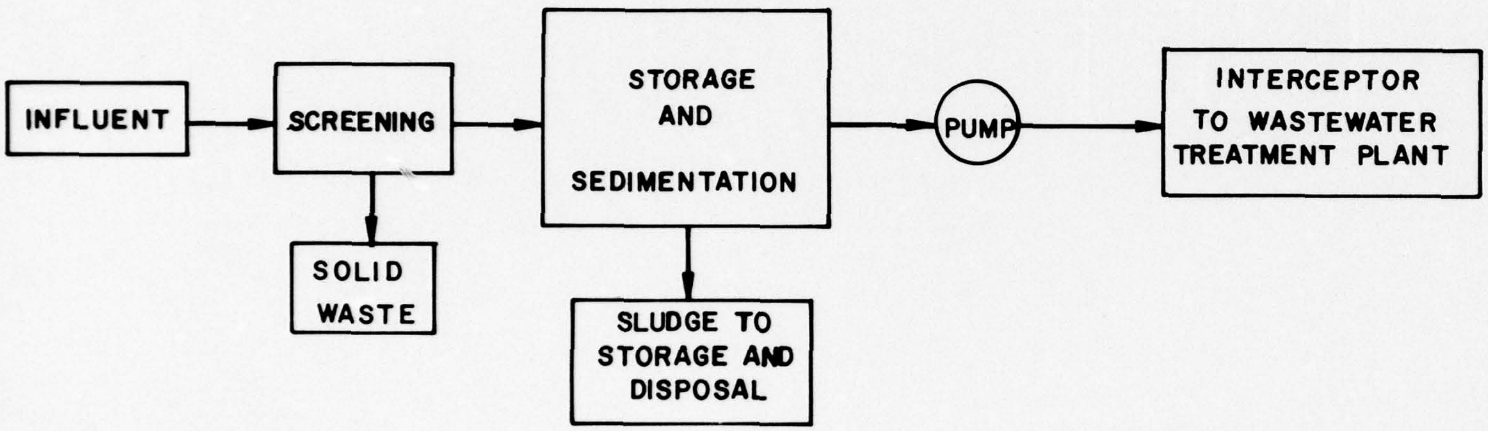
24. This system has also been designed to satisfy the lower two levels of treatment. Figure D-3 illustrates this system. The system provides for upsystem storage and regulated pumping into an existing or proposed interceptor which carries the combined flow to the municipal plant. The municipal wastewater plants have been designed and based on the domestic and industrial contributions as



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

STORMWATER SCHEMATIC
UPSYSTEM STORAGE &
TREATMENT
LEVEL I, LEVEL 2

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

STORMWATER SCHEMATIC
TREATMENT AT
WASTEWATER TREATMENT
PLANT

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

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VOLUME III ANNEX B FIGURE D-3

discussed in previous sections. The combined flows received at the plant, which are in excess of the design flows, are diverted to separate stormwater treatment facilities. The Level 1 facility includes sedimentation and disinfection. The Level 2 facility includes sedimentation, microstraining, and disinfection. The effluents discharged from these Level 1 and Level 2 facilities are equivalent to the Upsystem Storage and Treatment Level 1 and Level 2 quality for stormwater.

DESIGN STORM

25. Another variable that plays an important part in wastewater management planning is the size of storm for which to design the stormwater treatment system. Stormwater treatment components have been sized and costed for 1-, 5-, and 10-year storms.

SECTION E

FORMULATING THE PLANS

FORMULATING THE PLANS

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SECTION E

FORMULATING THE PLANS

Specific Planning Considerations

1. During the progress of this study, several specific problems were investigated which affect the development of the areawide wastewater management plans. These specific problems are: the combined sewer overflows, the water treatment plant wastes, industrial pretreatment, waste flow reduction, agricultural runoff, non-structural wastewater management, septic tank areas, infiltration/inflow, and regionalization.

COMBINED SEWER OVERFLOWS

OMAHA-MISSOURI RIVER

2. A number of planning considerations are important to developing solutions to combined sewer overflow problems. These are: (1) design storm recurrence interval, (2) pollutant concentration and magnitude of pollutant load, (3) treatment goals, and (4) the range of feasible alternatives.

3. For initial planning purposes, design storm recurrence intervals of 1-, 2-, 5-, and 10-years were selected. These intervals were considered to allow an analysis of the effectiveness and cost effects of alternative design storms. Volumes and rates of discharge were computed for the four design storms.

4. Pollutant concentration was determined by a literature search of sampled combined overflows. Concentrations ranged from 250 mg/l BOD and 400 mg/l SS at the beginning of the overflow to 50 mg/l BOD_5 and 220 mg/l SS near the end of the event. Average concentrations of 100 mg/l BOD_5 and 250 mg/l SS were selected. Volumes per storm event times pollutant concentration were computed to determine pollutant magnitude.

5. The three treatment levels for stormwater contained in the previous sections were used as treatment goals for the combined overflows. These goals were later refined based on EPA's water quality strategy for combined overflows.

6. More than thirty concepts were originally considered for the Omaha-Missouri River drainage area. Table E-1 illustrates the alternatives that were initially discussed with Federal, State, and local agencies and the reasons why they were rejected. Table E-2 lists the alternatives that were considered in the initial planning stages.

Table E-1

Initial Alternative Concepts Eliminated from Further Consideration

Concept Description	Reason for Elimination from Further Consideration
High-rate filtration at overflow points	Technically and economically unattractive.
Micro-straining at the overflow points	Technically and economically unattractive.
Swirlflow separator	Technically inadequate to meet minimum desired level of treatment.
High-rate disinfection	Inadequate treatment if used alone.
Biological or physical-chemical treatment as a part of any scheme with storage	All treatment facilities can be used comparably for most alternatives so that the selection of a particular treatment process will not favor one alternative concept over another.
Storage in collapsible bags	Number of bags required is excessive - too costly.
Storage on rooftops, parking lots, etc.	Inadequate storage available - too costly to provide now.
Conveyance by gravity sewers to large storage reservoirs	Gravity conveyance unpractical because of large diameters and excessive slopes required.
Conveyance by forcemain to large storage reservoirs	Pumping stations and power requirements too costly for pumping peak overflow rates to storage.

Table E-1
(Cont'd)
Initial Alternative Concepts Eliminated from Further Consideration

Concept Description	Reason for Elimination from Further Consideration
Storage of overflow in quarry reservoir	Quarry is located too far away to be practical.
Pump stored overflow to treatment facility in new forcemain, parallel to existing interceptor system	Ignores unused capacity of existing interceptor system.
Pumped storage facility as part of mined storage scheme	Not enough electrical demand close enough to study area to be practical.
Concrete storage tanks at airport, under runways	Distance too far to convey flows by gravity and storage costs would be excessive.
Storage in deep tunnel conveyance by enlarging tunnel diameters	Inadequate storage in tunnel system and cost of tumels as a storage facility is too expensive.
In-stream aeration	Will not meet PL 92-500 regulations.

Table E-2
Initial Combined Sewer Alternatives

1. Buried storage at outfalls.
2. Diked storage along levee.
3. Upstream retention.
4A. Deep tunnel north to ground level storage.
4B. Excavated storage north - deep tunnel south to ground storage.
5A. Deep tunnel with mined storage.
5B. Excavated storage north - deep tunnel to mined storage south.
6. Flow-through treatment with storage at outfall.
7. Sewer separation.
A. In-system attenuation devices.
B. Deep tunnel to the Papillion Creek S.T.P.
C. Flow-through treatment for "First-Flush".

LITTLE PAPILLION CREEK AND INDIAN CREEK OVERFLOWS

7. From experiences gained in the analysis of the Omaha-Missouri River overflows, some adjustments were made in considerations for the two other combined sewer areas.

8. The design storm range and pollutant concentrations analyzed are the same as for the Omaha-Missouri River drainage area. Treatment levels were reduced to reflect EPA's water quality strategy. These levels are the same as discussed under Planning Criteria for Stormwater. The alternatives were narrowed to sewer separation, upstream storage and treatment prior to discharge, and upstream storage and conveyance for treatment at a central location.

URBAN STORM RUNOFF

9. The 1-, 5-, and 10-year storms were considered in the urban stormwater analyses. Pollutant concentrations were determined by literature research and verified by analysis of street sweepings. These concentrations varied according to land use and are indicated in table E-3. Alternatives investigated were upstream storage treatment/discharge, and upstream storage/conveyance for treatment at a central location.

WATER TREATMENT PLANT SLUDGES

10. The disposal of water treatment plant sludges is a subject which potentially affects the wastewater management study. The following discussions concern this problem, with special attention given to the disposal of these wastes at existing municipal wastewater treatment plants.

GENERAL DESCRIPTION

11. The numerous alternatives available for disposal of water plant wastes can be grouped into two broad categories: (1) on-site treatment of wastes with off-site ultimate disposal; and (2) transport to a remote or regional site for treatment and ultimate disposal. The principle variables include the following:

- Type of treatment - thickener, vacuum filter, lagoons, existing wastewater treatment plant.

- Ultimate disposal technique - incineration, landfill, land application.

Table E-3

Average Annual Stormwater Runoff Concentrations of Pollutant Parameters

Land Use	Suspended Solids (mg/l)	BOD_5 (mg/l)	COD (mg/l)	Phosphorus as P (mg/l)	Nitrogen as N (mg/l)
Residential (2-5 ppa)[1]	300	20	150	0.70	3.1
Residential (5-8 ppa)	340	22	160	0.66	2.9
Residential (8-12 ppa)	380	24	170	0.62	2.7
Residential (12-15 ppa)	420	26	180	0.58	2.5
Residential (15-18 ppa)	460	28	190	0.54	2.3
Residential (18-20 ppa)	500	30	200	0.50	2.2
Residential Combined Sewer Overflows	250	100	400	4.00	10.0
Commercial and Industrial	500	30	200	0.50	2.2
Feedlots[2]	7,000	5,000	20,000	30.00	300.0
Iowa Agricultural (Adequate Controls)	3,000	20	30	.20	5.0
Iowa Agricultural (Needing Control)	40,000	25	350	2.80	65.0
Iowa Rural (Adequate Controls)	500	0.3	5	.002	1.0
Iowa Rural (Needing Control)	5,000	3.5	50	.04	8.0
Nebraska Agricultural (Adequate Controls)	4,000	3	40	.30	7.0
Nebraska Agricultural (Needing Control)	40,000	25	350	2.60	65.0

Table E-3
(Cont'd)
Average Annual Stormwater Runoff Concentrations of Pollutant Parameters

Land Use	Suspended Solids (mg/l)	BOD_5 (mg/l)	COD (mg/l)	Phosphorus as P (mg/l)	Nitrogen as N (mg/l)
Nebraska Rural (Adequate Controls)	700	0.6	8	.001	1.0
Nebraska Rural (Needing Control)	4,000	2.5	20	.020	5.0
Open/Public	200	3.0	50	.200	2.0

(1) ppa = people/acre
(2) Concentrations for runoff directly off feedlots.

* Transport mode - truck, force main, existing sewer.

12. A detailed study was not intended here, but rather an investigation of one particular aspect of this problem, the effect of water plant wastes on the design and operation of wastewater management plants.

ALTERNATIVE COSTS

13. For this analysis, two alternatives were designed and costed as a case study for Council Bluffs.

* Alternative 1 - The water plant wastes are mixed with the residential and industrial wastes in the influent sewer and treated at the wastewater treatment plant, to wastewater Levels 1 and 2.

* Alternative 2 - The water plant wastes are treated separately by dewatering and landfill. The wastewater treatment plant is designed to produce the quality related to wastewater Levels 1 and 2 for the residential and industrial wastewater only. Table E-4 illustrates the capital and O&M costs for these alternatives and their differences.

Table E-4
Water Plant Waste Control Costs - Council Bluffs

	Level 1		Level 2	
	Capital* ($1,000)	O&M** ($1,000/yr)	Capital* ($1,000)	O&M** ($1,000/yr)
Alternative 1				
Wastewater Plant, only	8,695	1,025	9,054	1,363
Alternative 2				
Wastewater Plant	6,865	751	8,066	1,127
Water Plant	1,165	122	1,165	122
Alt. 2 - Total	8,080	873	9,231	1,249
Difference (Alt. 1 - Alt. 2)	665	152	-177	114

* 1977 Capital Expenditures to satisfy specified Level of treatment and 1995 projected loads.

** 1995 Annual Operation and Maintenance Costs based on projected 1995 loads

14. The capital and O&M Costs for the combined treatment are more expensive than costs incurred for separate systems in Level 1. The reason for this is due primarily to the increased costs of sludge handling. The resulting mixture of the inorganic water plant wastes and the organic wastewater sludges is treated as wastewater sludge in the combined approach. In the separate approach, the inorganic sludges are treated and disposed of by a lower-cost method due to the reduced amount of organic material.

15. At treatment Level 2, the combined system becomes more viable. Two factors affect the costs in this situation; sludge and nitrification. The flow of inorganic wastes from the water plant is masked

by the higher levels of inorganic wastes produced by chemical treatment in Level 2. Requirements for nitrification are reduced because of the increased solids removed due to the water plant wastes. The net result of these factors is a lower capital expense and an increased O&M expense for the combined approach.

16. The analysis shows that for Level 1 wastewater treatment, which meets water quality standards, the water plant waste generally should be treated separately at the water treatment plant. If Level 2 treatment of wastewater is required, the combination of water plant wastes with the wastewater becomes more viable and should be considered on a site specific study. The numerous smaller plants should also be studied individually where sludges are landfilled or spread on agricultural land rather than incinerated and where Level 2 treatment may be required by water quality consideration.

17. Based on the above analysis, water treatment plant sludges were not incorporated into sewage treatment plant design and costing. Water treatment plant sludge handling by conventional methods is included in Annex C - Water Supply Plan Formulation Annex.

INDUSTRIAL PRETREATMENT

18. Control of industrial waste discharges is imperative for the reliable operation of a wastewater system; both treatment and collection. The study area is presently dominated by the food-processing industry (SIC 20) and this trend is expected to continue. Generally, the wastes for this industry are susceptible to treatment although excessive strengths and shock loads may cause problems.

Salt brines are also a problem, especially in alternatives which use land treatment methods, since major irrigation quality parameters are the Sodium Adsorption Ratio (SAR) and total dissolved solids (TDS).

19. The most troublesome wastes from the other industrial classifications encountered are the heavy metals. Excessive heavy metals concentrations may be toxic to man and to wastewater treatment systems. The heavy metal problem is not totally caused by industry. Significant quantities of metals have been measured in residential flows.

20. The removal of heavy metals is generally accomplished by chemical addition to provide precipitation at high pH. Removal at the source is more cost-effective than removal at a municipal treatment plant and future planning should emphasize treatment of industrial sources prior to discharge to local sewers. No critical condition is apparent with existing data, but surveillance of metals concentrations should be continued in order to develop the data source necessary to spot possible problems in the future.

21. Pretreatment practices are also appropriate for some of the other industries that exist in the area. The EPA has prepared and is preparing effluent guidelines for several industrial classifications as a requirement of Public Law 92-500. These guidelines will provide future direction to the planning process.

22. Reducing the problems associated with food-processing wastes can be attacked in several ways:

- Reduce water consumption;
- Recovery of blood and paunch in dried form;
- Recovery of grease;
- Centralized pretreatment; and
- Diversion to municipal wastewater plant.

23. These alternatives are generally understood and will not be discussed individually. Two developments in the area of pretreatment of food-processing wastes have occurred in the study area; (1) the Omaha centralized meat packing waste-processing plant; and (2) the Council Bluffs blood and paunch drying plant. The experiment at the Beefland International Plant in Council Bluffs has shown that collecting and drying blood and paunch reduced the BOD load significantly and at a reasonable cost.

24. The centralized pretreatment of meat-packing and food-processing wastes has been implemented in Omaha at the OPCC plant. The plant was designed to treat 15 mgd of water-carried paunch, blood, and grease from 18 processors. The plant consists of a solids flotation process for separation of solids and a solids recovery process for recovery of by-products.

25. Unfortunately, the plant has been plagued by operational problems; particularly in the solids recovery section which is presently inoperative. The separation process stream is operating essentially as designed but extreme corrosion has caused numerous

equipment breakdowns. The exact source of the excess corrosion is unknown but the waste is characterized by high chlorides and low pH.

26. Maintaining this plant to pretreat the strong and variable wastes from the food processors is beneficial to the total wastewater management system. Such a facility will stabilize the flow and load to the Missouri River plant, treat a more concentrated waste, and prevent build-up of grease and gross solids in the downstream sewers; this will provide better reliability, better cost-effectiveness, and reduced maintenance problems. Retention of the OPCC plant has been assumed in all plans.

27. Salt brines are also a problem in the study area and are probably attributable to SIC 20. Salts are of concern in land treatment alternatives. Currently the salt concentration in Council Bluffs effluent is too high for use in land irrigation; the Omaha-Missouri River plant's salt concentration approaches acceptable limits, while salt concentration at the new Papillion Creek plant is expected to be well within acceptable limits. The combined Missouri River and Papillion Creek effluents are within acceptable limits.

NON-URBAN PLANT TREATMENT TECHNOLOGY

28. The most popular treatment technologies currently used by non-urban plants are stabilization ponds, activitated sludge processes, and trickling filters. For planning and costing purposes, the aerated ditch modification of the activated sludge system was used as the base process unit for simplicity of operation, power conservation, reliability, and applicability to process additions.

29. There is a preference to stabilization ponds by communities in the study area and by the State environmental control agencies. Figures E-1 and E-2 compare the costs-per-treatment level of the aerated ditch versus conventional and zero-discharge stabilization ponds. The curves show that the stabilization ponds are less expensive (conventional versus Level 1 and zero-discharge versus Level 3).

30. In wet years the ponds could potentially discharge a strong waste. They would also require periodic dredging. Although the reliability is lower, studies of individual systems may show that ponds could provide a viable alternative to the processes chosen for this study.

FLOW REDUCTION

31. As part of the Urban Study, the consulting firm of Henningson, Durham, and Richardson has completed a Regional Water Supply Study of the Metropolitan Omaha-Council Bluffs area. One of the findings of this study that has a direct effect on the wastewater management study deals with potential water conservation practices.

RESIDENTIAL FLOW REDUCTION

32. Certain conservation efforts affect wastewater management due to a reduction of the domestic production of wastewater. Several structural and non-structural methods of water use reduction are considered in the study. Table E-5 shows the possible effect that some of these methods have on the flow coming from the dwelling unit. The effect of three such devices is shown in the table; water conserving toilets, shower heads, and washing machines. Another structural method would require the use of a dual supply

system. Although this system is interesting from a supply standpoint, wastewater production would probably be unaffected.

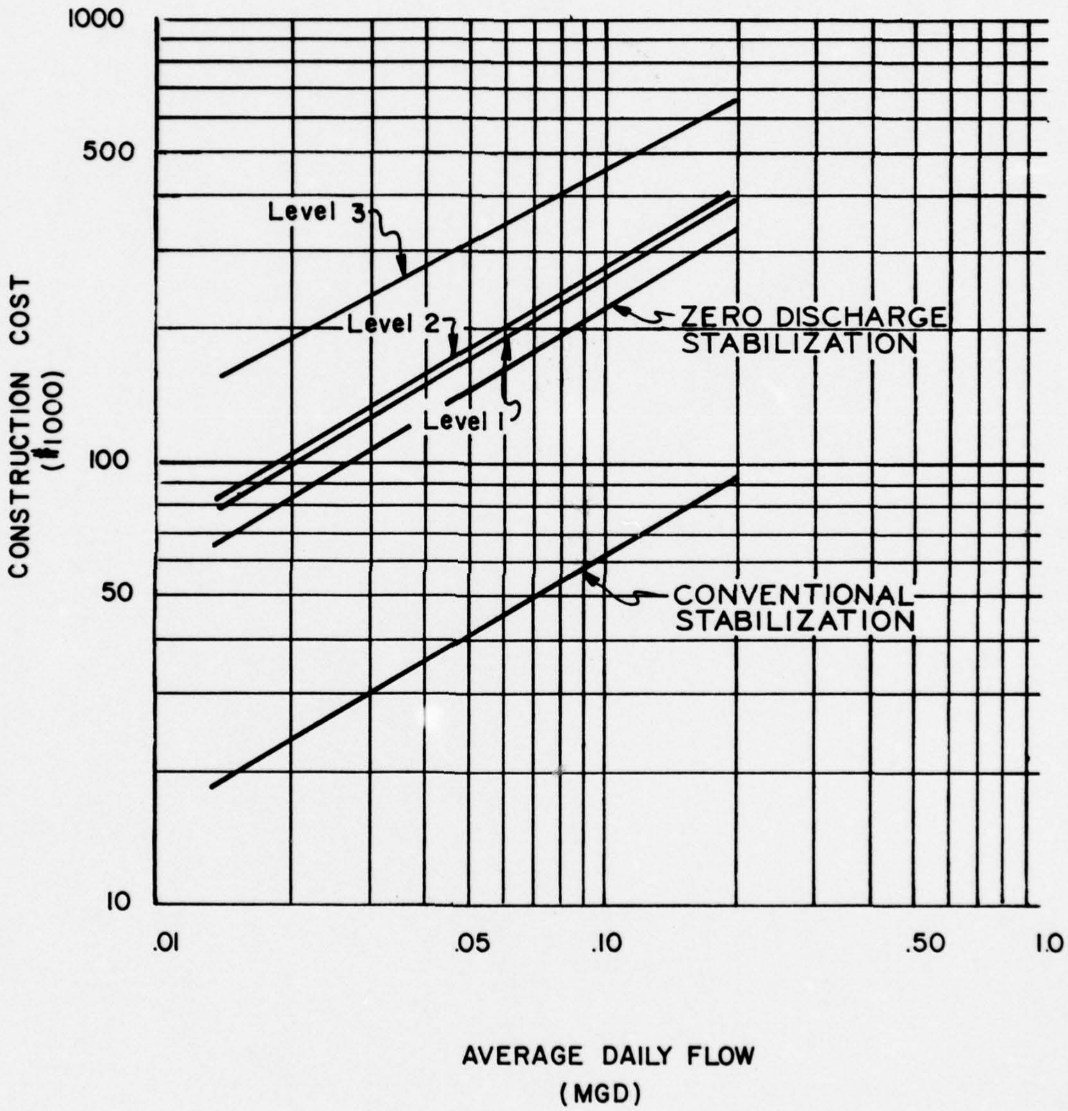
Table E-5
Water Use Reduction

Conservation Method	Sewage Flow Reduction (%) Per Dwelling Unit
Pricing of water (50%) increase in cost	5
Metering of "flat rate" areas	25
Water conserving devices	
Toilet	19
Shower heads	13
Washing machines	7
Dual water supplies	0

EFFECT OF FLOW REDUCTION ON COST

33. If all the residents of the area were to use all the water-conserving devices listed in table E-5, a total reduction in flow from the household would be 39 percent. If full areawide implementation of flow reduction devices were possible by 1995, the 39 percent reduction in residential flow would result in a net flow reduction of about 16 percent at the Missouri River Plant, 19 percent at the Mosquito Creek Plant, and 36 percent at the Papillion Creek Plant. The variation is due to the flows not affected by such devices.

34. The Papillion Creek Plant (most affected in flow) was evaluated to determine the possible cost reduction. The analysis indicated a capital cost reduction of 9 percent and an O&M reduction of 13



NON- URBAN PLANT

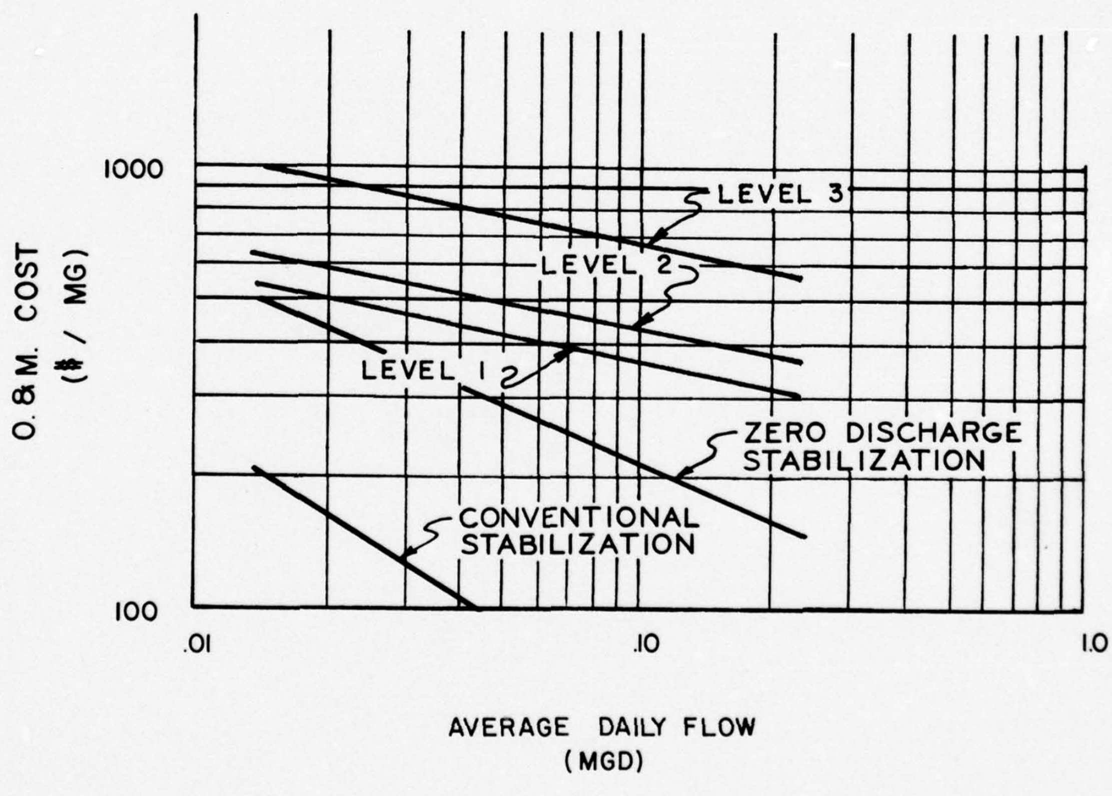
CAPITAL COST

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

NON-URBAN PLANT
CAPITAL COST

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

HAVENS AND EMERSON, LTD.



NON-URBAN PLANT
O &M COST

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
NON-URBAN PLANT
O & M COST
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

percent. An analysis of the minor urban process indicates reductions of 13 percent and 14 percent for capital and O&M, respectively, assuming full implementation resulting in 39 percent reduction in the residential flows.

35. Although individual studies would be required to determine specific cost reductions, this brief analysis indicates possible cost reductions of from 10 to 15 percent, assuming a 39 percent domestic flow reduction. Cost reductions are significantly less than flow reductions because many of the sewage treatment processes are based on organic rather than hydraulic loading. Since the effect is rather small, and there is considerable question as to the legal and social feasibility of fully implementing such a program, residential flow reduction was not included in sizing and costing of treatment plants. Implementation of flow reduction at some future date would extend the hydraulic capacity at the treatment plants.

INDUSTRIAL FLOW REDUCTION

36. Projections for industrial flows were based on 1974 rates per SIC classification. No significant changes through conservation or reuse practices are assumed to be made either by the year 1995 or 2020. In this respect, the projections are conservative.

37. The largest industrial classification, SIC 20, has already taken steps to reduce flows. For instance, the OPCC plant was designed to pretreat 15 mgd of meat processing wastes. While animal kill has remained relatively stable, current average flows are about 5 mgd.

STORM RUNOFF FLOW REDUCTION

38. For areas served by combined sewers, such methods as storage on rooftops and parking lots, and in-system attenuation were considered as means of reducing the flow rate. Rooftop and parking lot storage was rejected on the basis of cost and inadequate storage capacity. In-system attenuation was retained for further consideration.

39. Flow reduction of separate storm runoff was considered in a separate in-house study. It has been estimated that annual runoff volumes could be reduced by 70 percent by routing storm runoff over a previous area equal in size to the amount of impervious surface in a drainage area. While this would reduce annual operating and maintenance costs, it would have less effect on larger storms such as the one-year event.

AGRICULTURAL RUNOFF

40. A report entitled, "Agricultural Pollutants", was prepared by the Corps of Engineers on agricultural pollution within the Metropolitan Omaha, Nebraska - Council Bluffs, Iowa Study area. This report is included as part of the Supporting Technical Reports Appendix. The purpose of the report was to discuss and outline the source of agricultural pollutants and to qualify and quantify the potential of rural pollution within the study area. Included with the identification and analysis is a discussion on abatement methods, effectiveness of anticipated controls, current governmental legislation, and available assistance programs.

41. Site specific solutions to agricultural runoff problems are not included in the wastewater management plans. Applicable

measures to reduce agricultural runoff are slope terracing, contour farming, strip cropping, reduction of barren soil surface area, bank stabilization of streams, and small impoundment structures for land stabilization. These measures are fully explained in the "Agricultural Pollutants" report.

42. The drainage areas for four Papillion Creek damsites, three existing and one proposed, were analyzed to illustrate the effectiveness of the above measures. All sites analyzed indicated that good reductions of the inputs are possible; BOD - 78 to 93 percent; SS - 79 to 82 percent; P - 80 to 89 percent; and N - 68 to 83 percent. These reductions were assumed in projected future loads from agricultural lands for the years 1995-2020.

43. The Environmental Protection Agency has promulgated standards for the control of feedlot runoff. These standards call for the complete retention of the 10-year, 24-hour storm for existing feedlots, and the 25-year, 24-hour storm for new feedlot operations. These standards apply only to feedlots in excess of 1,000 head of cattle or 2,500 head of swine. Both Nebraska and Iowa have authority to require corrective action on feedlots of any size that create water quality problems. Nebraska standards require retention of the 10-year, 24-hour storm only. Iowa standards require that the facilities be sized to hold 4 inches of runoff.

44. Alternatives to meet feedlot runoff requirements are detailed in the "Agricultural Pollutants" report. Costs for these alternatives have not been included in the areawide wastewater management plans.

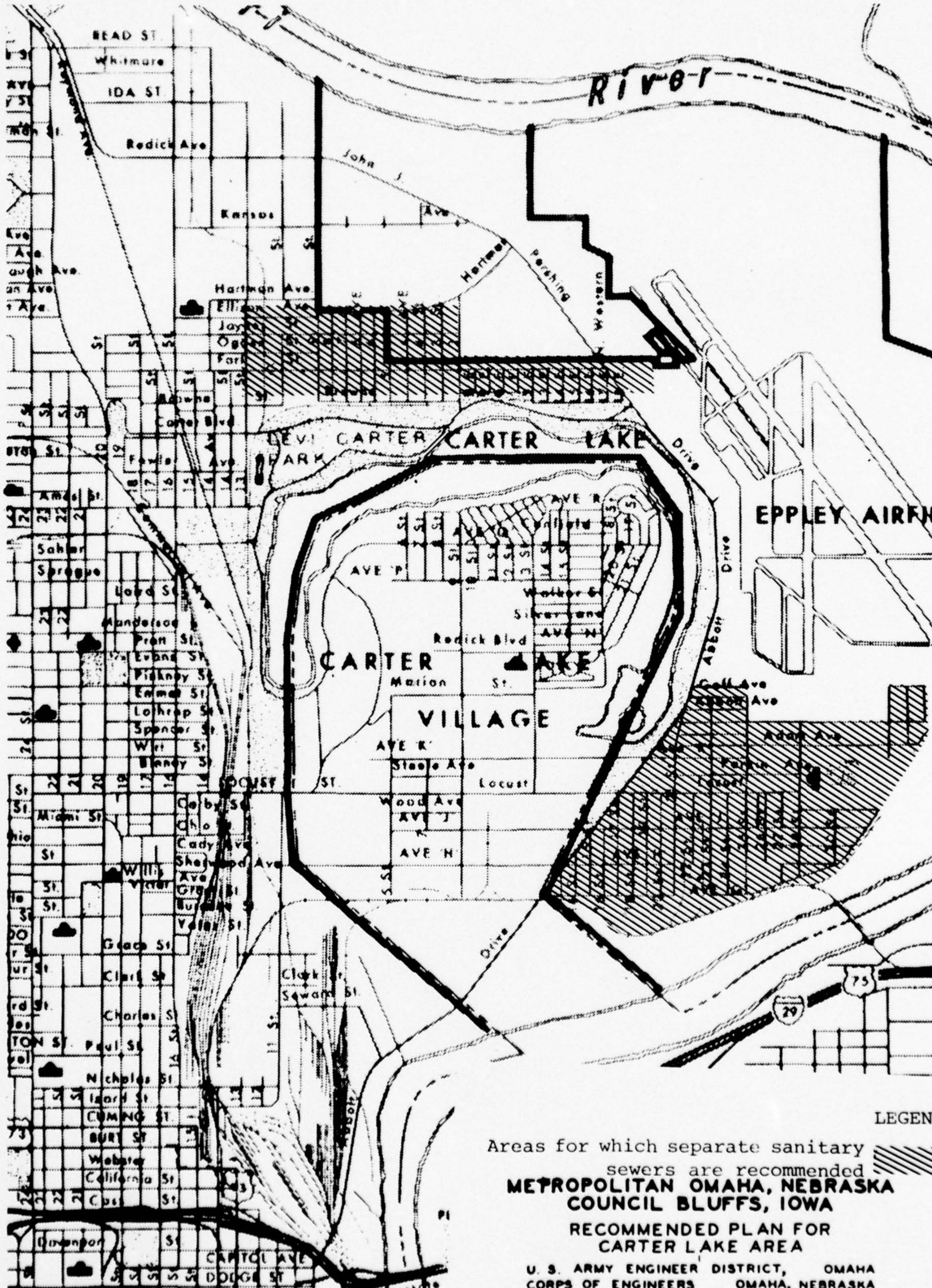
SEPTIC TANK AND GROUND WATER PROBLEMS - CARTER LAKE AREA

PROBLEM IDENTIFICATION

45. Problems with septic tank system performance and high ground water are prevalent in the area surrounding Carter Lake. The city of Omaha has extended sewerage service to Carter Lake, Iowa, to Eppley Airfield, and to several homes in East Omaha. The residents of East Omaha and the area north of Carter Lake use septic tank and tile field wastewater disposal systems. The problem areas are indicated in figure E-3.

46. As indicated by a survey of the residences in the East Omaha and North Area by the Douglas County Sanitarian, many of the septic tanks are undersized, the systems are 20 to 50 years old, and it is doubtful whether many of them have tile fields. Most of these systems were installed without having a percolation test made to determine the capability of the soil for a tile field. About half of the residents using septic tanks in this area have reported various degrees of difficulty with these septic tank systems during 1973.

47. The high ground water problem is not as well documented as the reported septic tank problems. The normal fluctuation of water levels does not affect existing structures at the airfield where the land surface is mostly above elevation 975 feet m.s.l. It does, however, cause infiltration to airport storm sewers, and occasionally has caused sufficient loss of the finer soil particles to cause collapse of the storm sewer. The County Sanitarian has reported that residents in the North Area and East Omaha have a problem with flooded crawl spaces, apparently caused by high ground water. No problems with high-water tables are reported for the village of Carter Lake.



METROPOLITAN OMAHA, NEBRASKA
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RECOMMENDED PLAN FOR
CARTER LAKE AREA

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE E-3

RECOMMENDED PLAN

48. The provision of a separate sanitary sewer system to convey wastewater from the East Omaha and the North Area to the Omaha-Missouri River sewage treatment plant is recommended for elimination of the problems associated with poor septic tank performance. Measures to alleviate the present problems caused by the high ground water levels are not recommended because of their technical infeasibility. In addition, any residual high-water table problem will be small if the septic tank problems are eliminated. It is however, recommended that future construction in the Carter Lake area incorporate appropriate provisions in recognition of the presence of a high ground water level.

INFILTRATION/INFLOW

49. The Federal Water Pollution Control Act Amendments of 1972 require all applicants for a treatment works grant after 1 July 1973, to perform, in conjunction with preliminary plans and studies, an analysis to determine the possible existence or non-existence of excessive infiltration/inflow in the applicant's sewer system.

50. As part of the Urban Study, infiltration/inflow analyses were conducted for the Omaha-Missouri River and Council Bluffs sewer systems.

OMAHA MISSOURI RIVER SYSTEM

51. The city of Omaha will be applying for a grant to construct a secondary expansion to the existing primary Omaha-Missouri River treatment plant. In order for Omaha to receive the construction grant, a sewer system evaluation was conducted by the city of Omaha

and the Corps of Engineers. The primary function of the evaluation was to determine whether or not the sewer system receives an excessive amount of extraneous flow caused by infiltration/inflow.

52. The city of Omaha made 24-hour, 7-day dry-weather flow measurements at 23 key manhole locations. Data on estimated water consumption and industrial discharges were compared to the dry-weather flow measurements for each sewer service area. The comparisons indicate that infiltration is not evident in the sewer system. Being a combined sewer system, extraneous inflow does exist. On an average basis, inflow amounts to 2.761 mgd or an "increase" of 12.8 percent over dry-weather flow. The only effective method to eliminate this inflow is sewer separation at a cost of approximately $500 million. A cost-effective analysis indicated that the inflow is not excessive. Details on the analysis are contained in the Supporting Technical Reports Appendix.

COUNCIL BLUFFS SYSTEM

53. An infiltration/inflow analysis for the Council Bluffs sewer system has been completed. The sewerage system for Council Bluffs was found to be reliable enough to use flow records at the treatment plant to conduct the analysis.

54. Flow records at the treatment plant were compared with water consumption data. The analysis determined that on an annual basis, approximately 1 million gallons per day of extraneous flow are received in the sewerage system.

55. Using the above data, it was determined that the cost to eliminate the extraneous flow would be approximately $11,000,000. Costs

to pump and treat the extraneous flow over a 20-year period would be approximately $100,000. Since the cost to pump and treat is less than the cost to eliminate, extraneous flow is not excessive in the system.

REGIONALIZATION

56. The degree of physical system regionalization is another plan development variable considered in this wastewater management study. Larger treatment facilities generally cost less to build and operate than many smaller plants of total equivalent size due to the "economy of scale". Sewer system costs are higher, however, for the large regional treatment plant; therefore, a study of costs and benefits is required. Varying degrees of regionalization are illustrated in the various alternative plans.

57. A significant amount of regionalization is being implemented according to the MAPA Comprehensive Water Pollution Control Plan of 1972. Based on requests from public works officials and the general public, the Urban Study analyzed the following:

- Lesser regionalization than in the MAPA plan based on land use concerns;

- More regionalization than in the MAPA plan based on water quality concerns;

- Integrating Omaha's two largest facilities into one treatment plant; and

• Retention of Bellevue's No. 1 treatment plant or incorporation of Omaha's facilities.

58. The decision that Council Bluffs' wastewater would not be physically integrated with Omaha's was made in the MAPA plan and not reanalyzed with the exception of land irrigation concepts.

Initial Plans

59. After review of the goals and objectives, the planning criteria, and the specific planning considerations, twelve initial alternatives were developed for the Omaha-Missouri River overflows and eight alternatives were considered for areawide wastewater management. The eight areawide plans include alternatives for wastewater, combined overflows in the Missouri River, Little Papillion Creek, and Indian Creek drainage areas, and stormwater runoff.

60. Planning for the Omaha-Missouri River overflows chronologically preceded other planning elements in order that plans would be available for the Facilities Planning Report on the Missouri River Sewage Treatment Plant. Selected initial overflow plans were then integrated into the areawide plans.

OMAHA-MISSOURI RIVER OVERFLOWS

61. Twelve alternative plans were initially formulated. The costs and subjective evaluation of the twelve alternatives are indicated in tables E-6 and E-7. The following are brief descriptions of each alternative and the reasons why some were eliminated. Federal, State, and local officials assisted in the alternative analyses.

ALTERNATIVE 1 - BURIED STORAGE AT OUTFALLS

62. This alternative uses buried concrete storage tanks located at the major overflow points along the main interceptor route. The stored overflows would be discharged to the existing interceptor system and treated at the upgraded Missouri River Treatment Plant. This alternative was eliminated because of the excessively high costs and site location and construction difficulties.

ALTERNATIVE 2 - DIKED STORAGE ALONG LEVEE

63. This alternative would use diked, open-storage reservoirs located in the Missouri River floodway outside the flood control levees. These elongated reservoir areas, located on the riverward side of the levee, would store the overflows for release to the existing interceptor system and treatment at the upgraded Missouri River Treatment Plant. This plan was selected for further evaluation.

ALTERNATIVE 3 - UPSTREAM RETENTION

64. This alternative would use a multitude of upstream retention sites for storage of overflows followed by release of the stored

Table E-6

COST OF ALTERNATIVES SIZED FOR 5 YEAR RECURRENCE INTERVAL

ALL COSTS IN MILLION OF DOLLARS

		System Components						Summary of Costs for Secondary Treatment at 7% Interest Rate				
		Conveyance		Storage		Treatment4/						
		Capital Cost	Annual O&M	Capital Cost	Annual O&M	Capital Cost	Annual O&M	Total of Capital Costs	Land Costs	Total Annual O&M	Present Worth of Annual Costs5/	Total Present Worth
1	Buried Storage at Outfalls	6.1	0.2	517.7	1.7	12.7	1.4	536.5	1.7	3.3	51.3	589.5
2	Diked Storage Along Levee	76.0	1.0	37.5	1.7	12.7	1.4	126.2	6.0	4.1	75.3	207.5
3	Upstream Retention	12.2	0.5	111.9	1.7	12.7	1.4	136.8	12.2	3.6	56.6	205.6
4 A	Deep Tunnel North to Ground Level Storage	128.5	0.3	18.1	1.7	12.7	1.4	159.3	2.2	3.4	53.1	214.6
4 B	Excavated Storage North-Deep tunnel South to Ground Storage	52.3	0.3	36.0	1.7	12.7	1.4	101.0	7.6	3.4	53.0	161.6
5 A	Deep Tunnel With Mined Storage	77.9	0.4	161.4	1.7	12.7	1.4	252.0	1.7	3.5	54.6	308.3
5 B	Excavated Storage North-Deep Tunnel to Mined Storage South	41.6	0.3	120.5	1.7	12.7	1.4	174.8	5.5	3.4	52.9	233.2
6	Flow-Through Treatment With Storage at Outfall	8.4	0.3	336.1	1.1	31.1	3.0	375.6	0.3	17.0	47.3	423.2
7	Sewer Separation1/	539.3	-	-	-	-	-	539.3	-	-	-	539.3
A	In-system Attenuation Devices 2/	-	-	70.2	0.3	12.7	1.4	82.9	1.7	1.7	39.5	123.4
B	Deep Tunnel to the Papillon Creek STP3/	96.0	0.1	110.8	1.9	3/	3/	206.8	-	2.0	29.8	236.6
C	Flow-Through Treatment for "First Flush"	-	-	-	-	278.9	0.3	278.9	2.4	0.3	55.5	336.8

1/ For storms of any recurrence intervals

2/ Capable of reducing number of overflows to several times per year

3/ Does not include treatment - regional concept

4/ Costs for higher levels of treatment can be obtained from Plate 8

5/ [illegible]udes costs for replacement

Table E-7
SUBJECTIVE EVALUATION

OF ALTERNATIVES

		Aesthetic Effects	Disruptive Effects	Likelihood of Public Acceptance	Treatment Attain-Ability	Flexibility for Staging	Site Availability	Maintenance and Operation	Redundancy Effect[1/]	Energy Use
1	Buried Storage at Outfalls	Good	Low	Good	Good	Good	Poor	Poor	Excellent	Good
2	Diked Storage Along Levee	Poor	Moderate	Fair	Good	Fair	Fair	Fair	Excellent	Poor
3.	Up-stream Retention	Poor	High	Poor	Fair	Good	Poor	Poor	Poor	Good
4A	Deep Tunnel north to Ground Level Storage	Fair	Low	Good	Good	Poor	Good	Good	Excellent	Fair
4B	Excavated Storage North-Deep Tunnel South to Ground Storage	Fair	Moderate	Fair	Good	Poor	Good	Fair	Good	Fair
5A	Deep Tunnel with Mined Storage	Good	Low	Excellent	Good	Poor	Good	Good	Excellent	Poor
5B	Excavated Storage North-Deep Tunnel to Mined Storage South	Fair	Moderate	Fair	Good	Poor	Good	Fair	Good	Fair
6	Flow-Through Treatment With Storage at Outfall	Poor	Moderate	Fair	Fair	Good	Fair	Poor	Poor	Good
7	Sewer Separation	Good	High	Poor	Excellent	Good	Good	Good	Poor	Good
A	In-System Attenuation Devices	Good	Moderate	Good	Poor	Good	Good	Poor	Poor	Good
B	Deep Tunnel to the Papillon Creek STP	Good	Low	Good	Excellent	Poor	Good	Good	Excellent	Poor
C	Flow-through Treatment for "First Flush"	Poor	Moderate	Fair	Poor	Good	Fair	Poor	Poor	Good

1/ Capability of preventing dry-weather overflows resulting from mechanical failure of pumping facility on interceptor system or breakdown of sewage treatment plant

overflows to the existing main sewer and interceptor system and treatment at the upgraded Missouri River Treatment Plant. These retention sites would consist of excavated, open reservoirs and buried concrete tanks located throughout the sewer system. Although this system is relatively low in total cost, there would be considerable disruption during construction and the completed system would be aesthetically unacceptable.

ALTERNATIVE 4A - DEEP TUNNEL NORTH TO GROUND-LEVEL STORAGE

65. This alternative uses the elevation differential between most of the service area and the Missouri River to provide energy for conveyance of the overflows to a low-cost storage site. The wastewater would flow through deep tunnels to a ground-level reservoir across the Missouri River north of Council Bluffs. The overflows would be pumped back to the existing interceptor system for treatment at the Missouri River Plant. This alternative was retained for further evaluation.

ALTERNATIVE 4B - EXCAVATED STORAGE NORTH - DEEP TUNNEL SOUTH TO GROUND STORAGE

66. This alternative deals separately with the northern and southern parts of the sewer system. In the northern area, overflows would be diverted to open excavated storage reservoirs in the Carter Lake area. Overflows in the southern areas, beginning with the Burt-Izard outfall, would be handled by a deep tunnel to a diked storage reservoir across the river south of Council Bluffs, Iowa. Treatment would be at the upgraded Missouri River plant. This alternative was retained for further evaluation.

ALTERNATIVE 5A - DEEP TUNNEL WITH MINED STORAGE

67. This alternative consists of conveyance of combined sewer overflows by deep tunnel to an underground storage reservoir excavated in rock below the Missouri River plant. The combined sewage would be pumped up to the plant for treatment. This alternative has the advantage of excellent potential for public acceptance since all of the facilities would be underground with no visual or aesthetic impact on the environment. This alternative was also retained for further evaluation.

ALTERNATIVE 5B - EXCAVATED STORAGE NORTH - DEEP TUNNEL TO MINED STORAGE SOUTH

68. This alternative requires two excavated storage reservoirs in the Carter Lake area comparable to those in Alternative 4B for the northern areas. The outfalls in the southern areas would discharge to a tunnel for conveyance to a mined storage facility. After storage, the overflows would be pumped to the interceptor or directly to the Missouri River plant for treatment. This alternative is very similar to Alternative 4B, but the mined storage makes it the most expensive of the five least-costly plans, $233 million (present worth). This alternative should be considered only if further evaluation indicates serious problems with implementing alternatives with storage at ground level.

ALTERNATIVE 6 - FLOW-THROUGH TREATMENT WITH STORAGE AT OUTFALLS

69. This alternative includes provision of storage at the outfall points for attenuation of the peak flows before pumping to flow-through treatment facilities. The treatment systems consist of initial screening for removal of coarse solids, pressurized

dissolved-air flotation, chemical addition, and chlorination for disinfection. It was rejected due to costs, operating difficulties, and inability to meet Level 1 treatment.

ALTERNATIVE 7 - SEWER SEPARATION

70. This alternative entails separation of existing combined sewers. It was assumed that storm runoff and snowmelt water would not require treatment and would be acceptable for discharge to the Missouri River. Projected cost of separation was estimated to be $27,000 per acre in Omaha. This would entail an estimated initial construction cost of about $500 million, considerably more than most of the other alternatives. This alternative was retained for consideration as a partial alternative.

ALTERNATIVE A - IN-SYSTEM ATTENUATION SOURCES

71. This alternative would use regulators for storing flows within the pipes of the combined sewer system. The flow would be controlled by remote controls and computer monitoring. This system has an estimated present worth cost of $123 million, but does not reduce the number of overflows to the desired level. It was rejected as a complete alternative for this reason, but was retained as a partial alternative.

ALTERNATIVE B - DEEP TUNNEL TO THE PAPILLION CREEK SEWAGE TREATMENT PLANT

72. This alternative entails deep-tunnel conveyance to a mined storage facility near the Papillion Creek Sewage Treatment Plant. This concept could be used to eliminate either the proposed secondary facility or the entire Missouri River Treatment Plant.

The wastewater from the Missouri River plant would also go to the Papillion Creek plant. Additional costs would be incurred for treatment of the combined sewer overflows. This plan was formulated so that it could be further evaluated as part of the regional wastewater management study.

ALTERNATIVE C - FLOW-THROUGH TREATMENT FOR "FIRST FLUSH"

73. The "first flush" of storm runoff is usually much stronger than the rest of the combined sewer overflow wastewater. Treatment units could be designed for placement at the outfall points to handle the more concentrated overflows. Subsequent overflows at lower concentration levels would be allowed to bypass to the river untreated. This alternative was rejected because of costs and inability to perform as well as the other alternatives.

NEW ALTERNATIVE 1

74. A new alternative was developed by the areawide wastewater consultant. This alternative uses buried concrete basins at selected overflow points for storage and minimal treatment before discharge to the Missouri River. This alternative does not provide the same effectiveness as many of the other alternatives but has a comparable cost (present worth $250.6 million) and is aesthetically acceptable.

SELECTED ALTERNATIVES

75. The alternatives selected for further refinement were:

- Alternative 2 - Diked storage along the levee;

- **Alternative 4A - Deep tunnel north to ground-level storage;**

- **Alternative 4B - Deep tunnel south and open-surface storage in the north;**

- **Alternative 5A - Deep tunnel to mixed storage; and**

- **Alternative B - Deep tunnel to Papillion Creek.**

Alternatives 7 and A were retained as partial alternatives applicable to any of the selected five.

AREAWIDE WASTEWATER MANAGEMENT PLANS

76. A general description of these plans is shown in table E-8, as related to the plan development variables. The treatment technology employed at the major, minor, and non-urban plants is designated "Treatment and Discharge" for the conventional treatment plants with direct discharge to the receiving stream or "Land Treatment System" for secondary effluent application on land systems. The treatment concept employed for the urban stormwater runoff is also indicated as "Upsystem Treatment and Discharge" or "Conveyance". The degree of regionalization is indicated by the number of plants within each of the categories.

77. The following paragraphs provide a discussion of each plan and its formulation strategy. Overflows in Papillion Creek and Indian Creek are provided with either upsystem treatment and discharge or conveyance. Omaha-Missouri River overflows use one of

Table E-8

GENERAL DESCRIPTION

REGIONAL WASTEWATER MANAGEMENT PLANS

		MUNICIPAL WASTEWATER SYSTEMS			COMBINED SEWER OVERFLOW & URBAN STORMWATER RUNOFF SYSTEMS		
PLAN	BRIEF DESCRIPTION	MAJOR URBAN	MINOR URBAN	NON-URBAN	OMAHA-MO. RIVER	PAPILLION BASIN	COUNCIL BLUFFS
I	Basic Plan	3 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
II	Basic Plan with limited extension of Papillion Creek Interceptor System	3 Plants Treatment & Discharge	11 Plants Treatment & Discharge	34 Plants Treatment & Dicharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
III	Basic Plan with stormwater treatment variation	3 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Conveyance to Missouri River Plant for treatment	Conveyance to Papillion Creek Plant for treatment	Conveyance to Mosquito Creek Plant for treatment
IV	Regionalization at Papillion Plant	2 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
V	Regionalization with stormwater treatment variation	2 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Conveyance to Papillion Creek Plant for treatment	Conveyance to Papillion Creek Plant for treatment	Conveyance to Mosquito Creek Plant for treatment
VI	Land treatment systems for all wastewater	3 Secondary Plants Transmission to Remote Land Treatment System	7 Secondary Plants Transmission to Local Land Treatment System	34 Secondary Plants Transmission to Local Land Treatment System	Conveyance to Missouri River Plant for treatment and Transmission to Remote Land Treatment System	Conveyance to Papillion Creek Plant for treatment and Transmission to Remote Land Treatment System	Conveyance to Mosquito Creek Plant for treatment and Transmission to Remote Land Treatment System
VII	Combination of land treatment system and treatment and discharge	3 Plants Treatment & Discharge	11 Secondary Plants Transmission to Local Land Treatment System	34 Secondary Plants Transmission to Local Land Treatment System	Conveyance to Missouri River Plant for treatment	Upsystem Treatment and Discharge	Upsystem Treatment and Discharge
VIII	Combination of land treatment system and treatment and discharge	3 Secondary Plants Transmission to Remote Land Treatment System	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge

the alternatives previously discussed or upstream treatment and discharge (New Alternative 1).

PLAN I (Figure E-4)

78. Plan I is the base plan for the study and is therefore used as the basis of comparison for several of the other plans. This plan is compatible with MAPA's Plan C with the inclusion of individual upsystem treatment plants for urban stormwater runoff and all combined sewer overflows. The Papillion sewer system is extended in this plan to Bellevue, Bennington, Elkhorn, and Gretna.

PLAN II (Figure E-5)

79. Plan II provides lesser extension of the Papillion sewer system (reduced regionalization) as compared to Plan I. This results in four additional permanent minor urban plants at Bellevue, Bennington, Elkhorn, and Gretna. The other major, minor, and non-urban plants are the same as Plan I. Individual upstream treatment plants are provided for the urban stormwater runoff and all combined overflows.

PLAN III (Figure E-6)

80. Plan III provides a wastewater treatment facilities layout identical to Plan I. In this plan, however, there is upsystem storage of the urban stormwater runoff and of the Papillion and Indian Creek overflows with regulated discharge to the major sanitary interceptors for treatment at the municipal plant sites. Alternative 5A from the Harza Engineering report, June 1974, was incorporated into this plan for the Omaha-Missouri River combined sewer area. This plan provides a comparison of stormwater treatment techniques.

LEGEND

PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

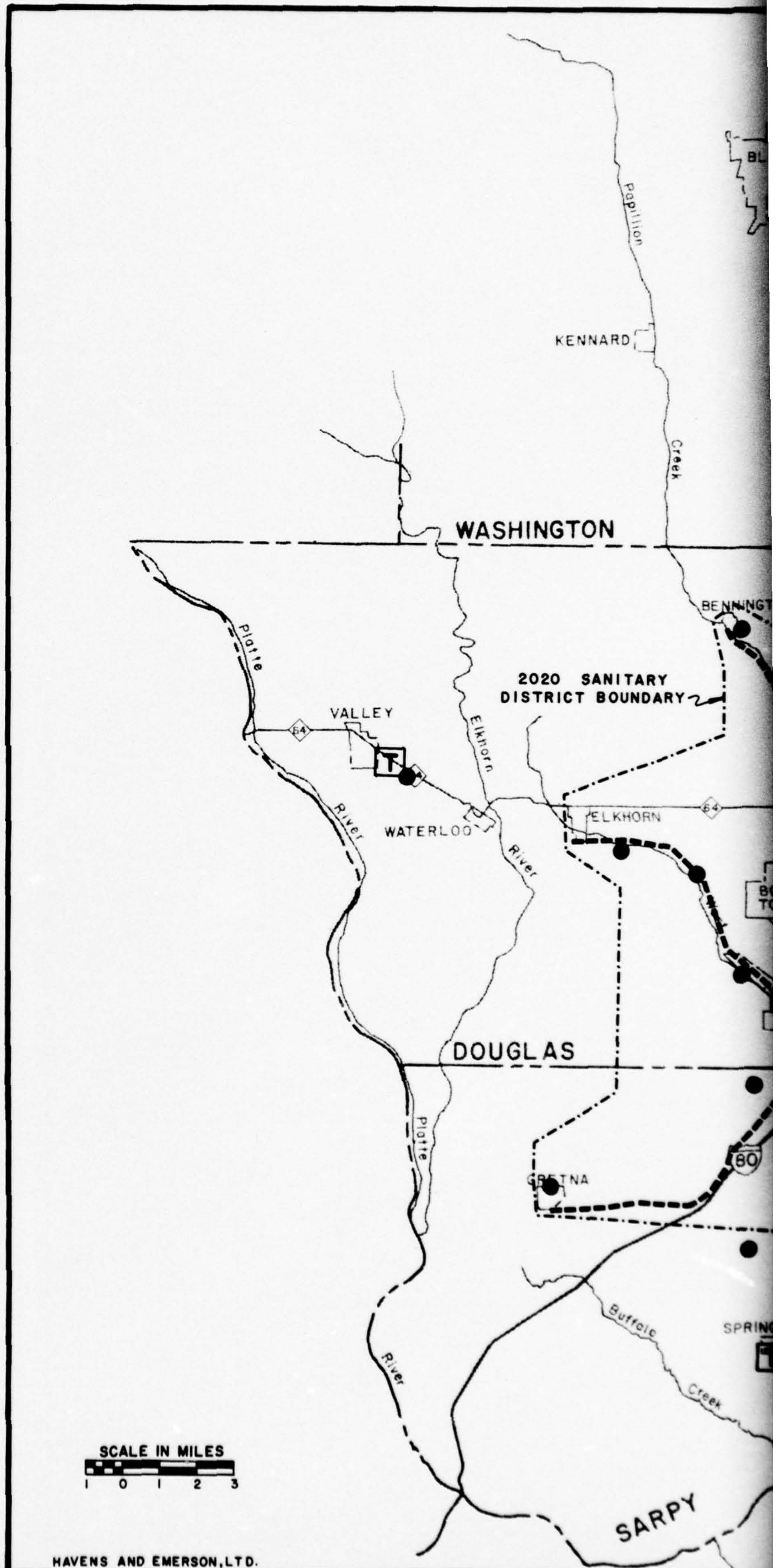
TREATMENT AND DISCHARGE TO DESIGNATED GOAL ●

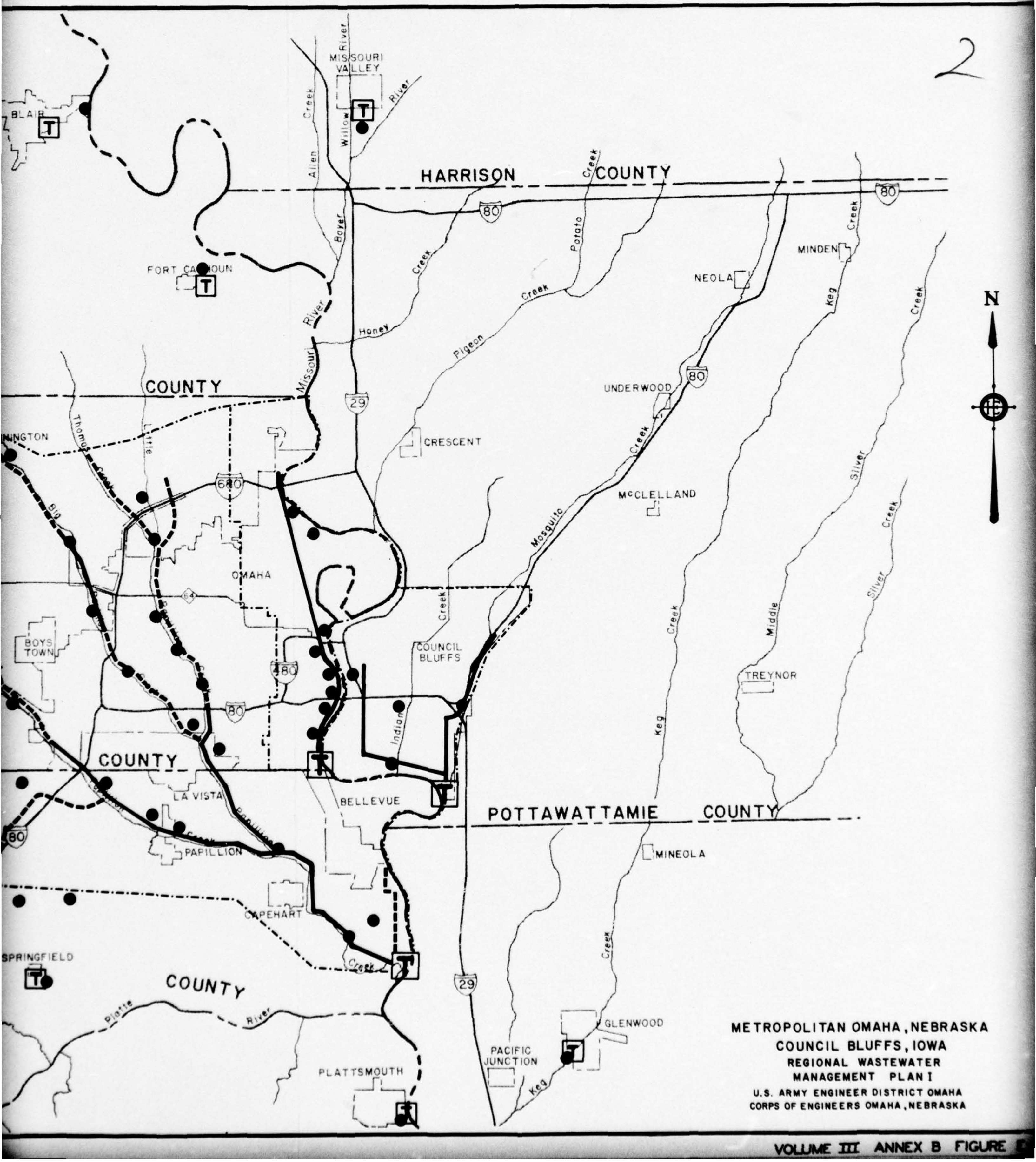
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY ○

TRANSMISSION FACILITIES

EXISTING

PROPOSED

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MISSOURI VALLEY
BLAIR
HARRISON COUNTY
FORT CALHOUN
NEOLA
MINDEN
UNDERWOOD
COUNTY
CRESCENT
McCLELLAND
OMAHA
BOYS TOWN
COUNCIL BLUFFS
TREYNOR
COUNTY
LA VISTA
BELLEVUE
POTTAWATTAMIE COUNTY
PAPILLION
MINEOLA
CAPEHART
SPRINGFIELD
COUNTY
GLENWOOD
PACIFIC JUNCTION
PLATTSMOUTH
N
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN I
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

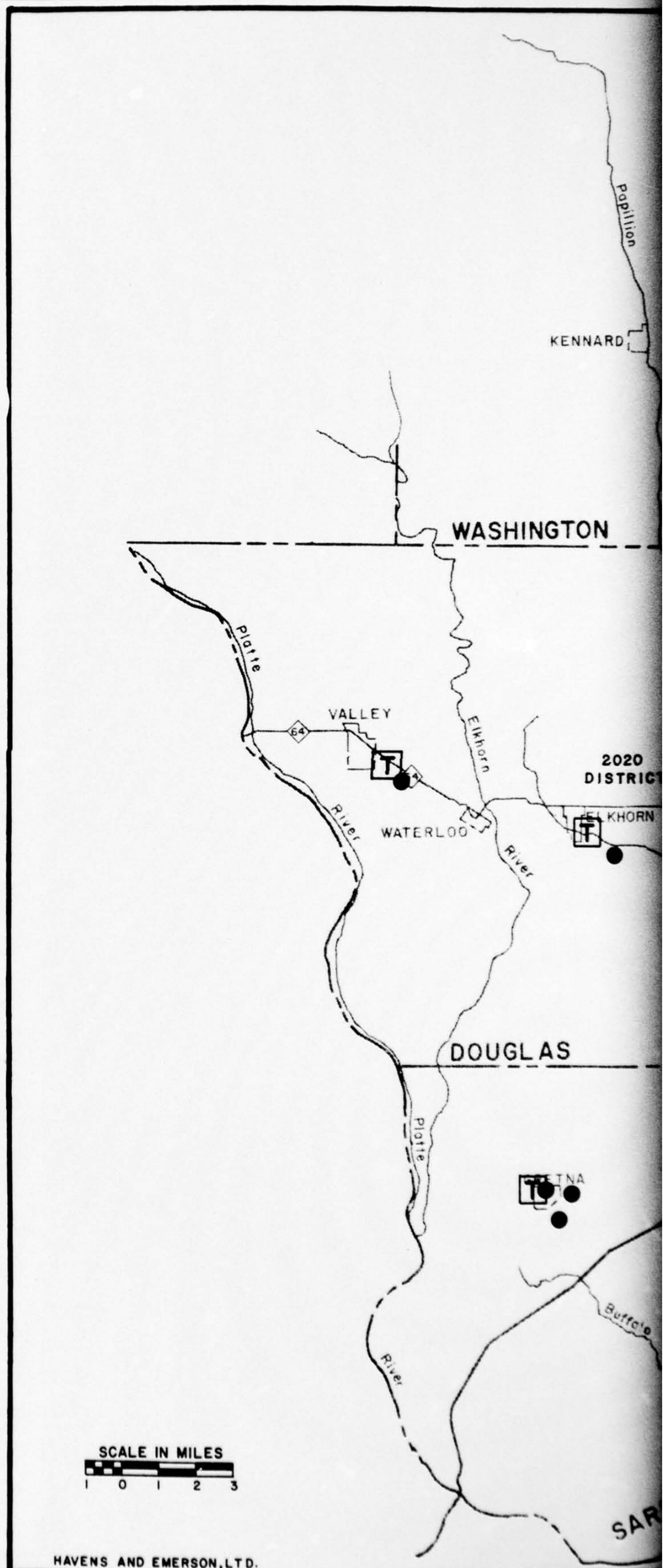
TREATMENT AND DISCHARGE TO DESIGNATED GOAL .... ●

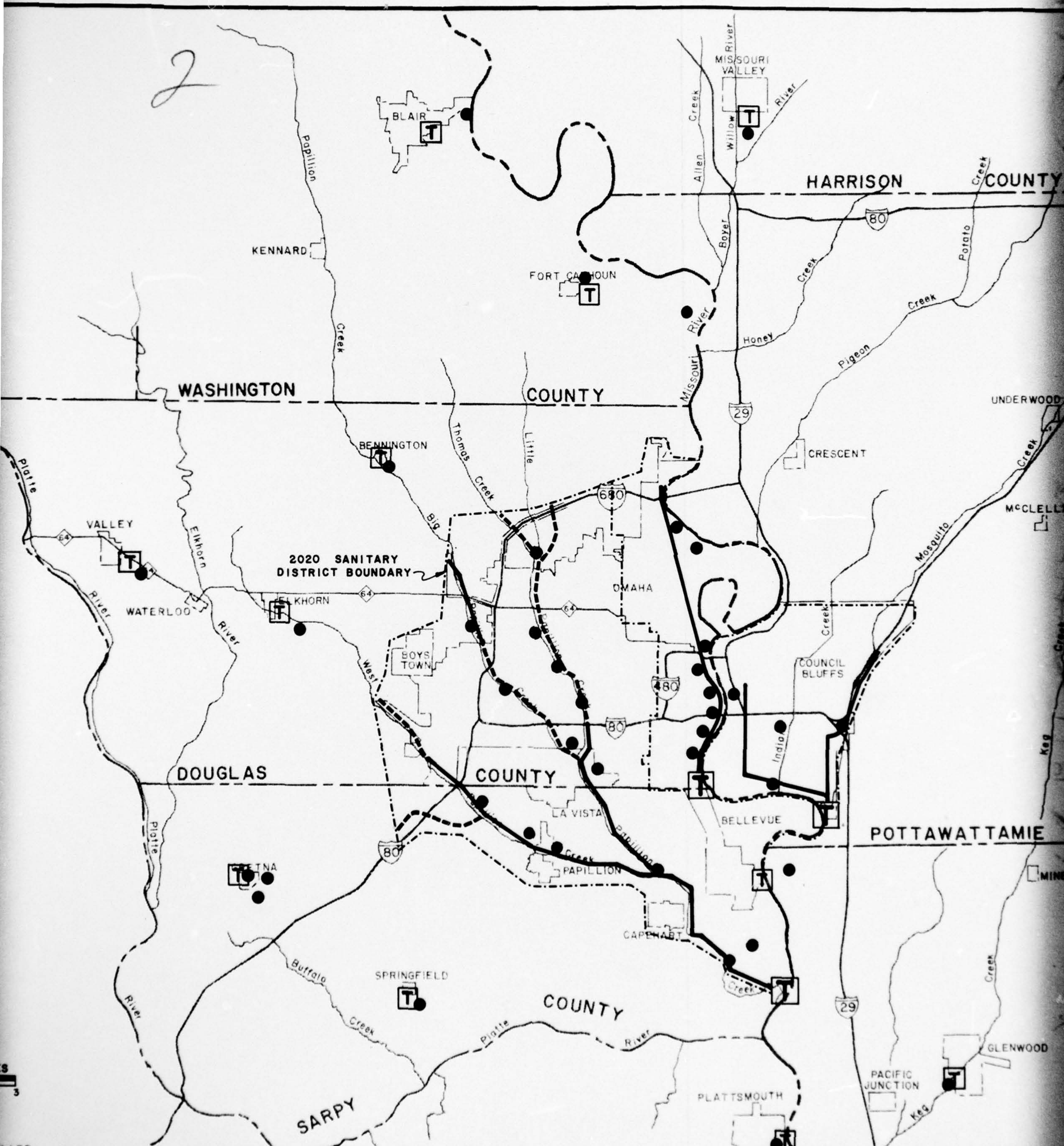
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY .... ○

TRANSMISSION FACILITIES

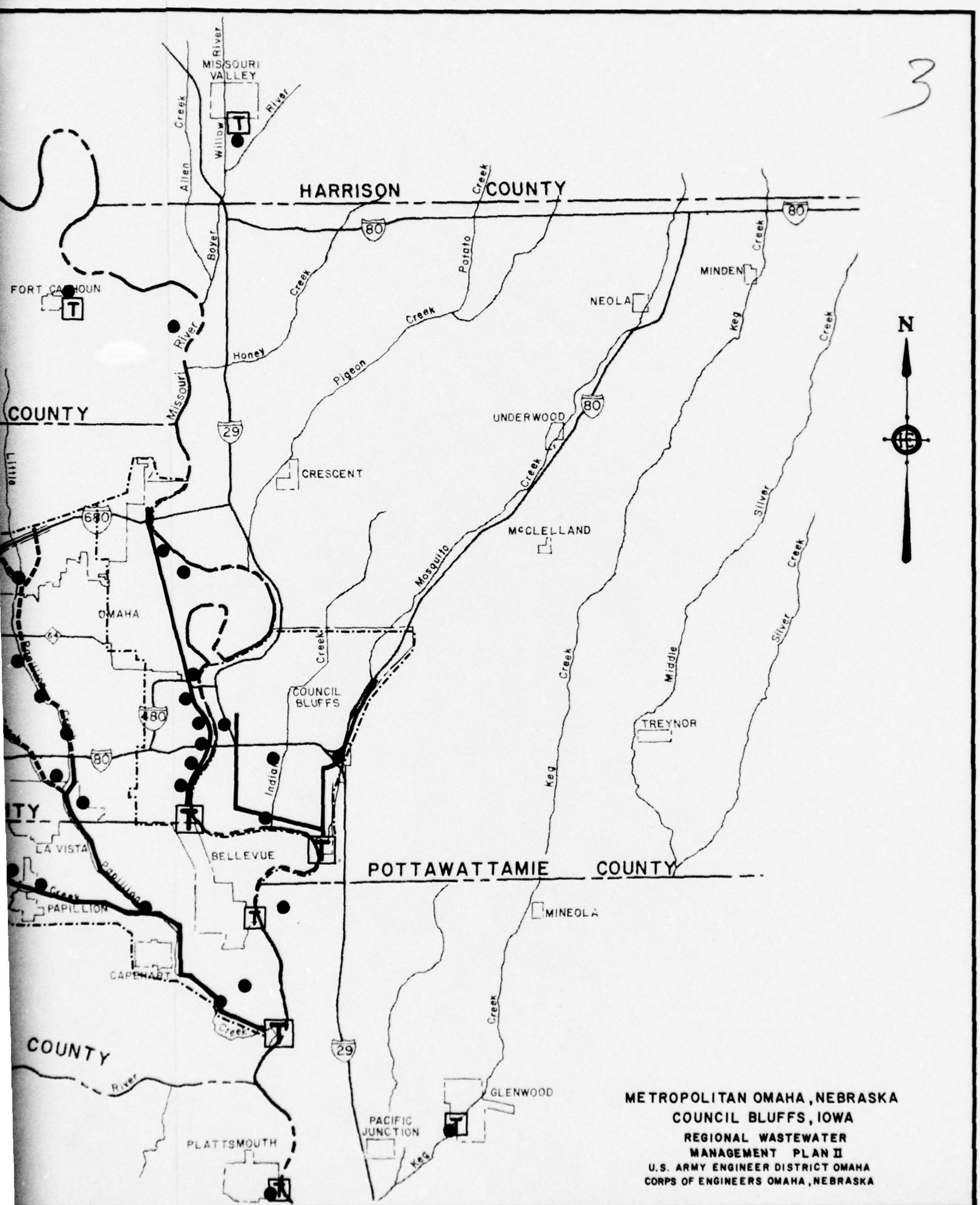
EXISTING ....

PROPOSED ....




2
HARRISON COUNTY
WASHINGTON COUNTY
DOUGLAS COUNTY
POTTAWATTAMIE
SARPY COUNTY
BLAIR
MISSOURI VALLEY
KENNARD
FORT CALHOUN
BENNINGTON
UNDERWOOD
CRESCENT
McCLELLAND
VALLEY
WATERLOO
ELKHORN
2020 SANITARY DISTRICT BOUNDARY
OMAHA
BOYS TOWN
COUNCIL BLUFFS
LA VISTA
BELLEVUE
PAPILLION
GRETNA
CAPEHART
SPRINGFIELD
PLATTSMOUTH
PACIFIC JUNCTION
GLENWOOD
MINDEN
Missouri River
Platte River
Elkhorn River
Papillion Creek
Big Papillion Creek
Little Papillion Creek
West Papillion Creek
Thomas Creek
Buffalo Creek
Willow River
Allen Creek
Boyer River
Honey Creek
Pigeon Creek
Potato Creek
Mosquito Creek
Keg Creek
Indian Creek
80
29
680
480
64
N,LTD.

3



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN II
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

VOLUME III ANNEX B FIGURE E-5

LEGEND

PLANT — MAJOR URBAN | MINOR URBAN

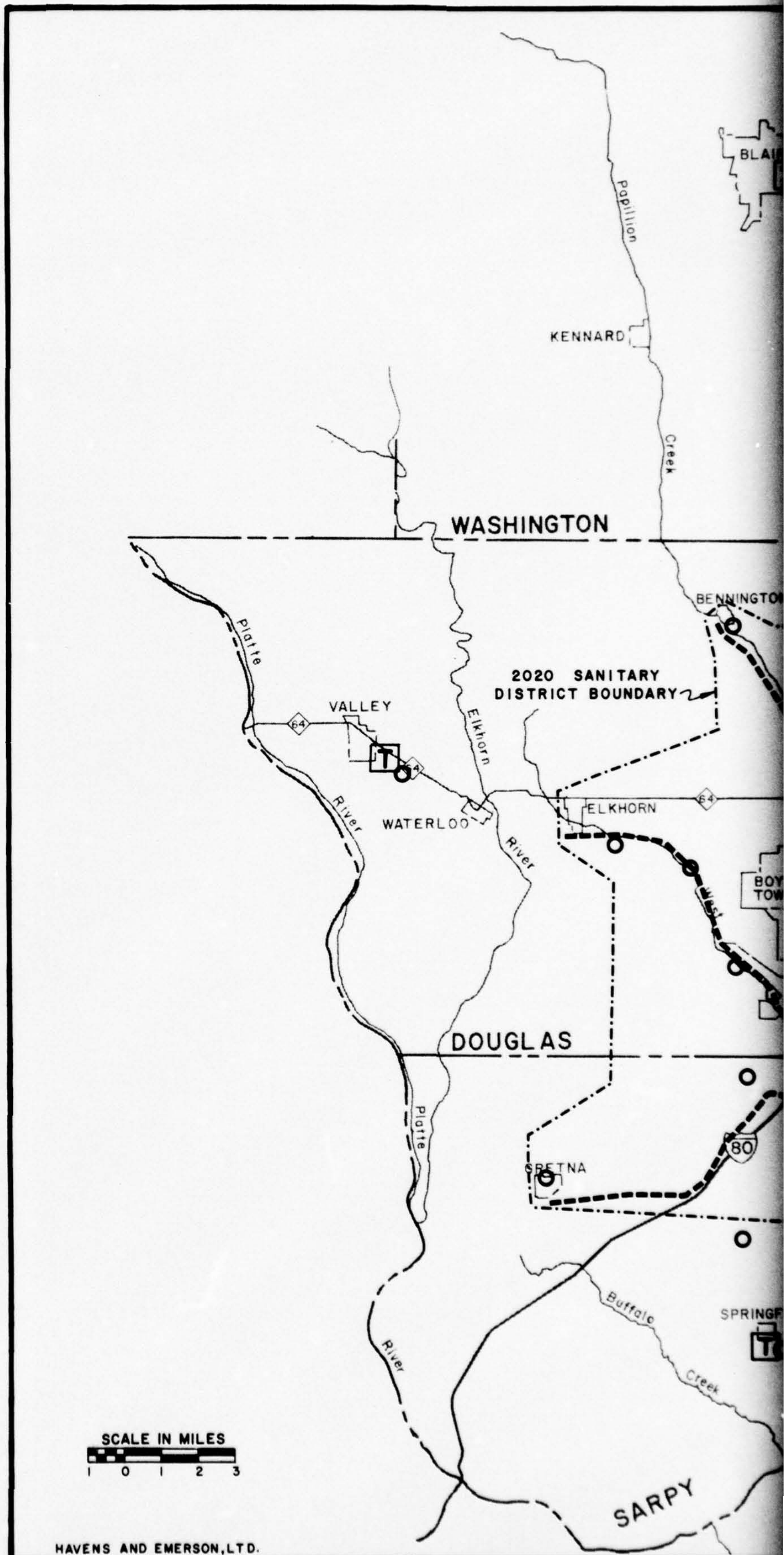
- TREATMENT AND DISCHARGE TO DESIGNATED GOAL: T | T
- SECONDARY TREATMENT PRIOR TO LAND APPLICATION: S | S

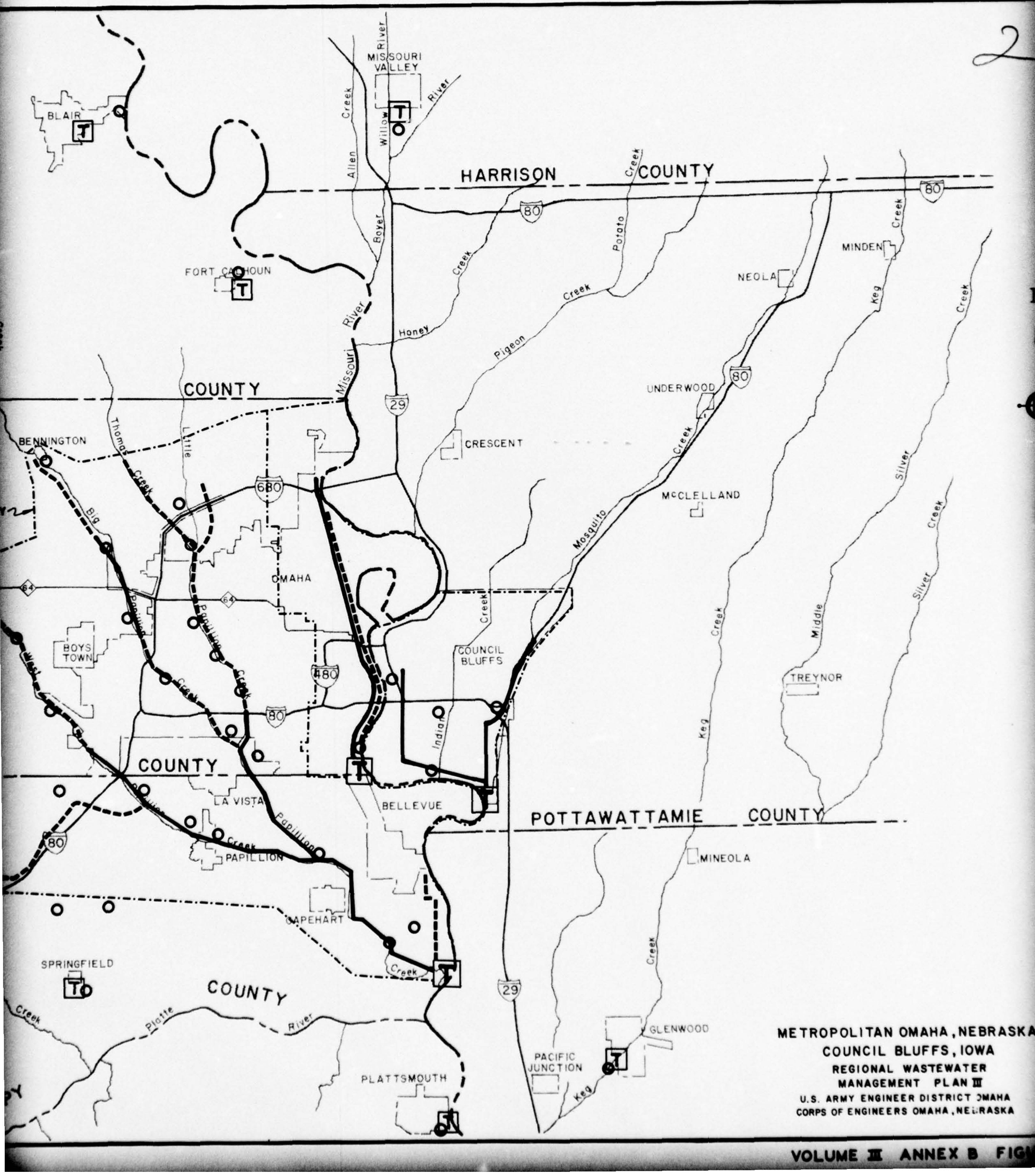
STORMWATER

- TREATMENT AND DISCHARGE TO DESIGNATED GOAL: ●
- STORAGE AND DISCHARGE TO TRANSMISSION FACILITY: ○

TRANSMISSION FACILITIES

- EXISTING: ————
- PROPOSED: - - - - -





METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN III
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLAN IV (Figure E-7)

81. Plan IV provides greater regionalization than Plan I by phasing out the Omaha-Missouri River plant and conveying this wastewater to the Papillion Creek plant. The Papillion Creek sewer system is identical to Plan I, as is the handling for urban stormwater runoff and all overflows with individual upsystem treatment plants.

PLAN V (Figure E-8)

82. Plan V provides a wastewater treatment facilities layout identical to Plan IV. In this plan, however, there is upsystem storage of the urban stormwater runoff and of the Papillion and Indian Creek overflows with regulated discharge to the major sanitary interceptors for treatment at the municipal plant sites. Alternative B. Harza Engineering Report, June 1974, was incorporated into this plan for the Omaha-Missouri River combined sewer area.

PLAN VI (Figures E-9 and E-10)

83. Plan VI provides a wastewater treatment, stormwater, and overflow treatment facilities layout identical to Plan III. In this plan, however, only Level 1 treatment is achieved at these facilities, with this effluent transported to land treatment systems.

84. In the minor and non-urban facilities, the effluent is stored and used for irrigation at local sites. The major secondary effluents are combined near the Papillion Creek plant and transported to irrigation sites west of the urban area. The sites required by 1995 are in the Saunders County area; 2020 flows will require additional sites in the Butler and Seward County areas.

85. The plan provides for the maximum development of land treatment and irrigation water for a comparison of land treatment systems with upgraded conventional treatment plants. It should be noted that the stormwater applied to the land treatment systems receives a higher degree of treatment than does the stormwater in Plans I through V.

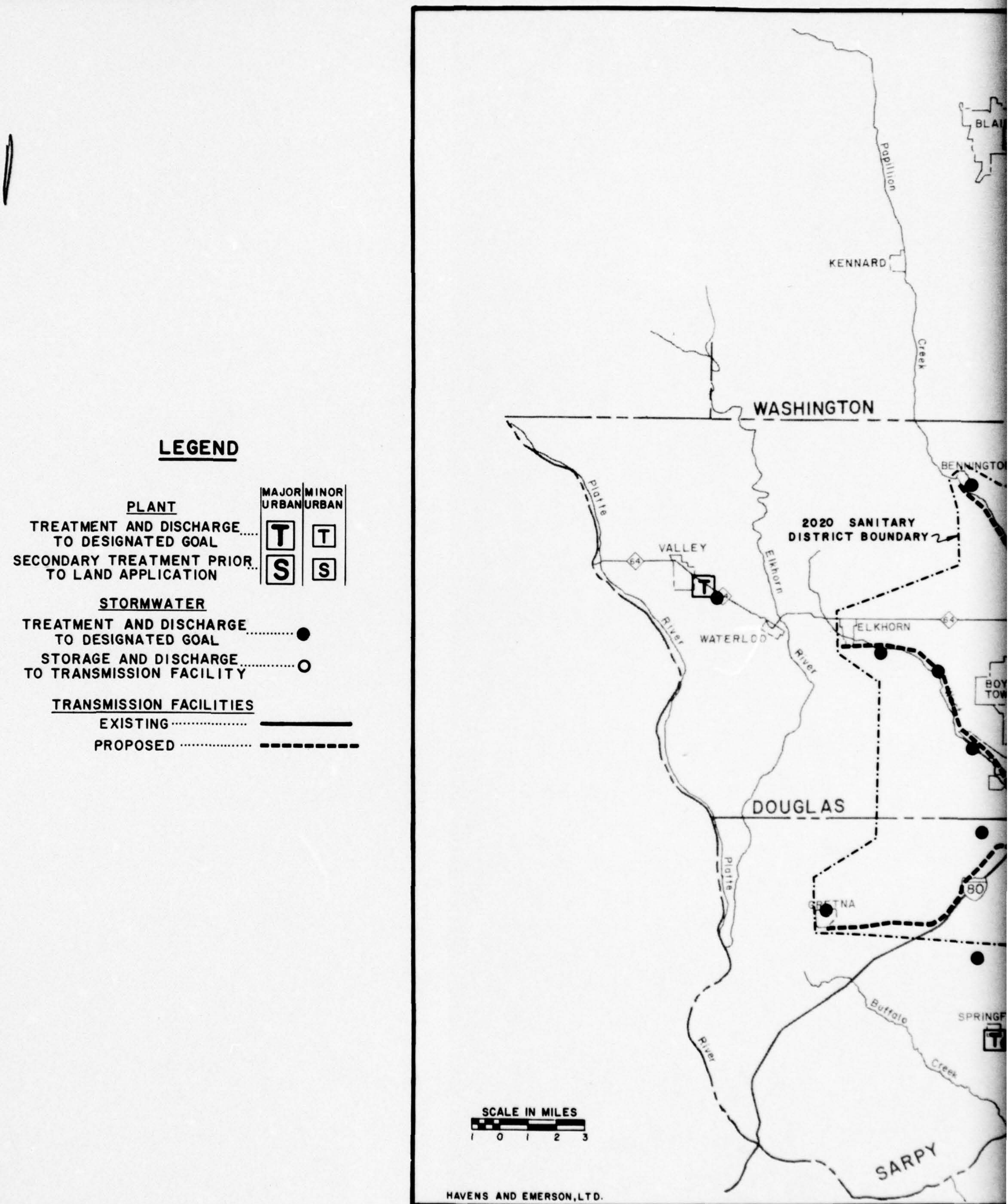
PLAN VII (Figures E-11 and E-12)

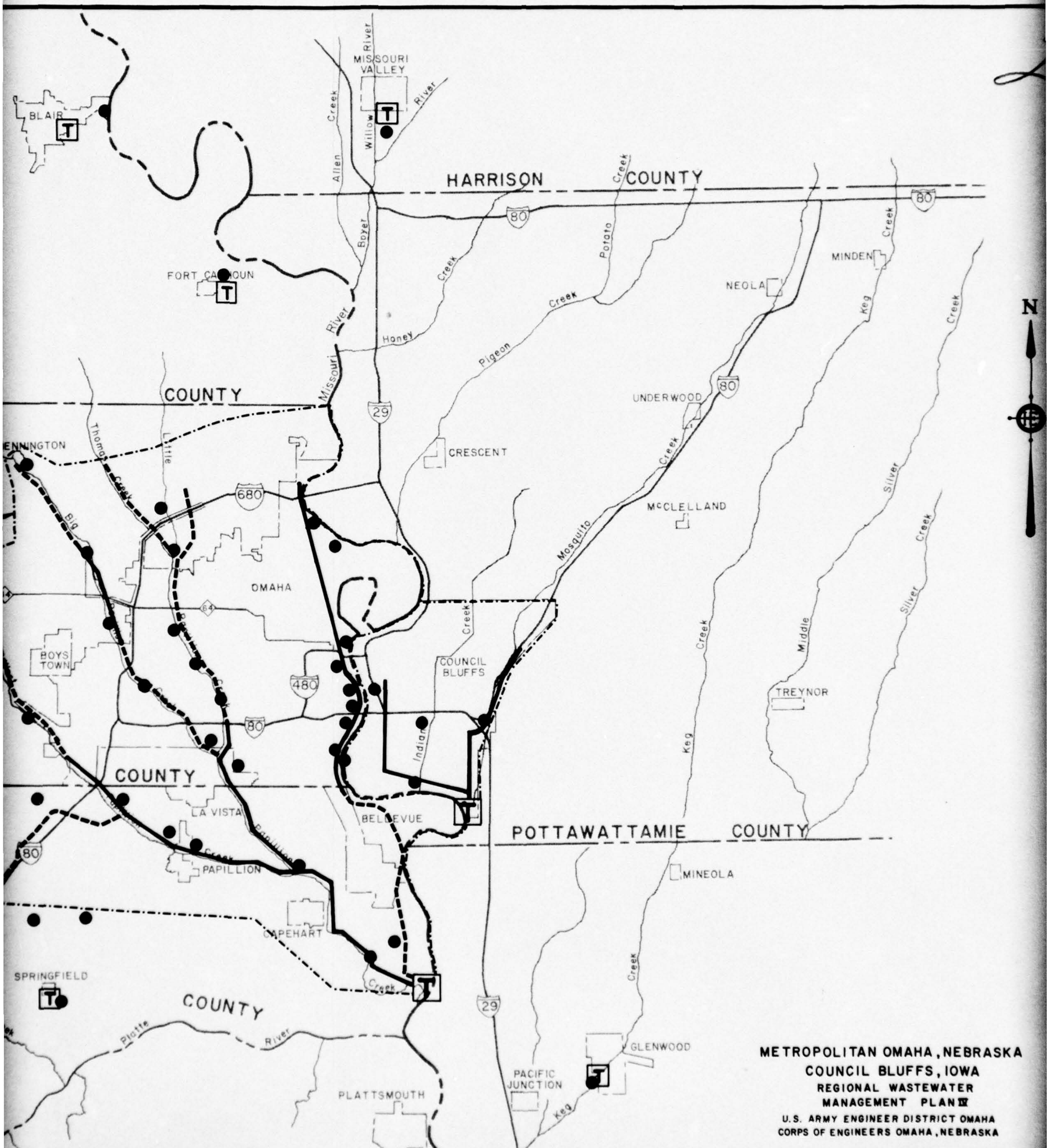
86. Plan VII provides a wastewater treatment, stormwater, and overflow facilities layout very similar to Plan II. The only exceptions are that the Bellevue flow is transported to the Papillion Creek plant and that Boys Town becomes a permanent minor urban plant. In this plan, however, all minor urban and non-urban plants employ local land treatment systems and the major urban plants employ upgraded conventional treatment with discharge to the Missouri River. Stormwater is handled by individual upsystem treatment plants with the exception of the Omaha-Missouri River combined sewer area for which Alternative 5A from the Harza Engineering report, June 1974, was used.

87. This plan provides the maximum amount of in-basin land treatment systems.

PLAN VIII (Figures E-13 and E-10)

88. This plan provides a wastewater treatment, stormwater, and overflow treatment facilities layout identical to Plan I. The minor and non-urban facilities are designed as upgraded conventional treatment plants with direct discharge to the receiving streams. The major urban facilities provide secondary treatment


LEGEND
MAJOR URBAN
MINOR URBAN
PLANT
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
SECONDARY TREATMENT PRIOR TO LAND APPLICATION
STORMWATER
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY
TRANSMISSION FACILITIES
EXISTING
PROPOSED
WASHINGTON
DOUGLAS
SARPY
2020 SANITARY DISTRICT BOUNDARY
Papillion Creek
KENNARD
BENNINGTON
VALLEY
WATERLOO
ELKHORN
Elkhorn River
Platte River
GRETNA
Buffalo Creek
64
80
SCALE IN MILES
1 0 1 2 3
HAVENS AND EMERSON, LTD.



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN IV
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

	MAJOR URBAN	MINOR URBAN
PLANT		
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

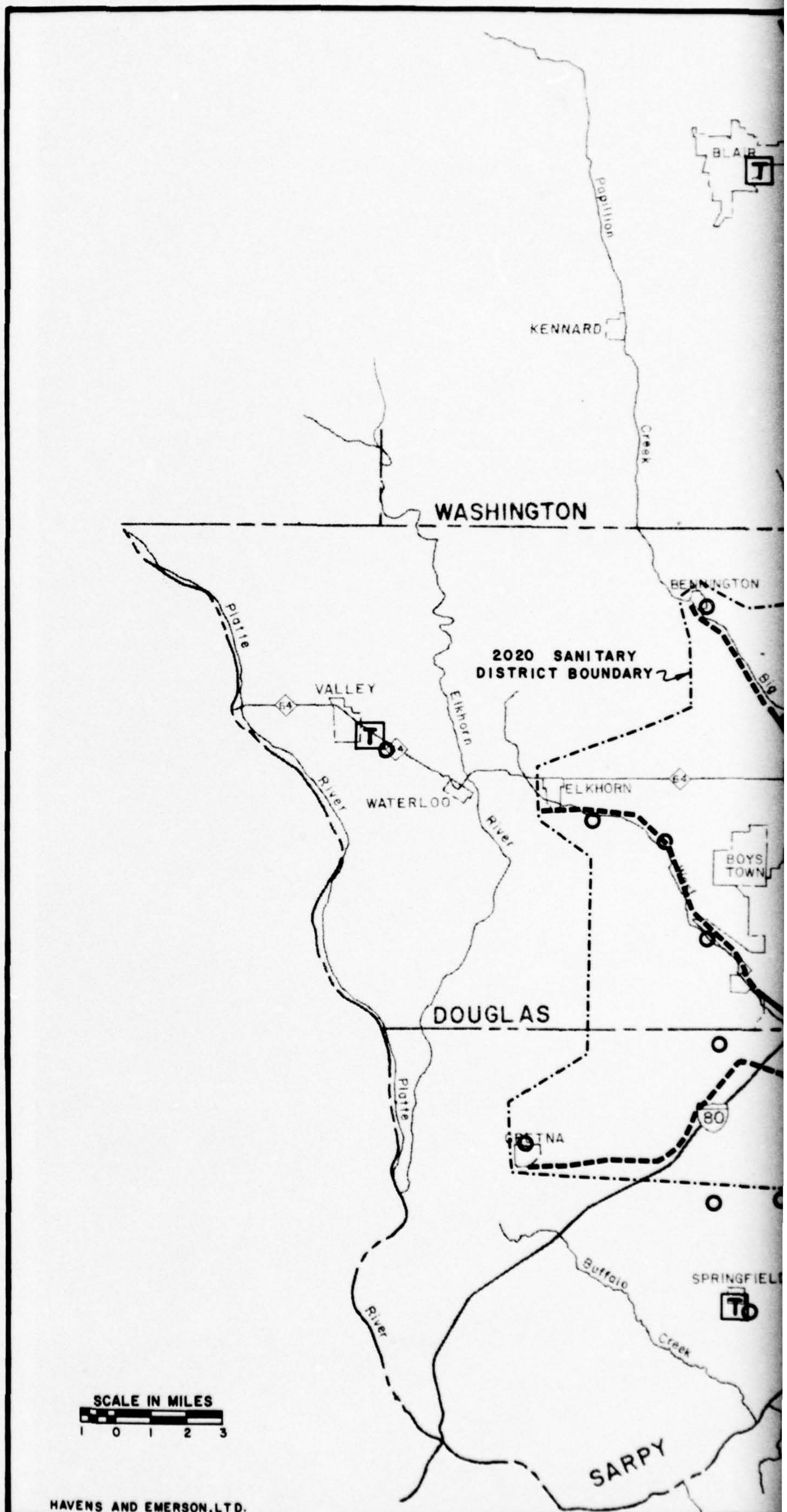
TREATMENT AND DISCHARGE TO DESIGNATED GOAL ●

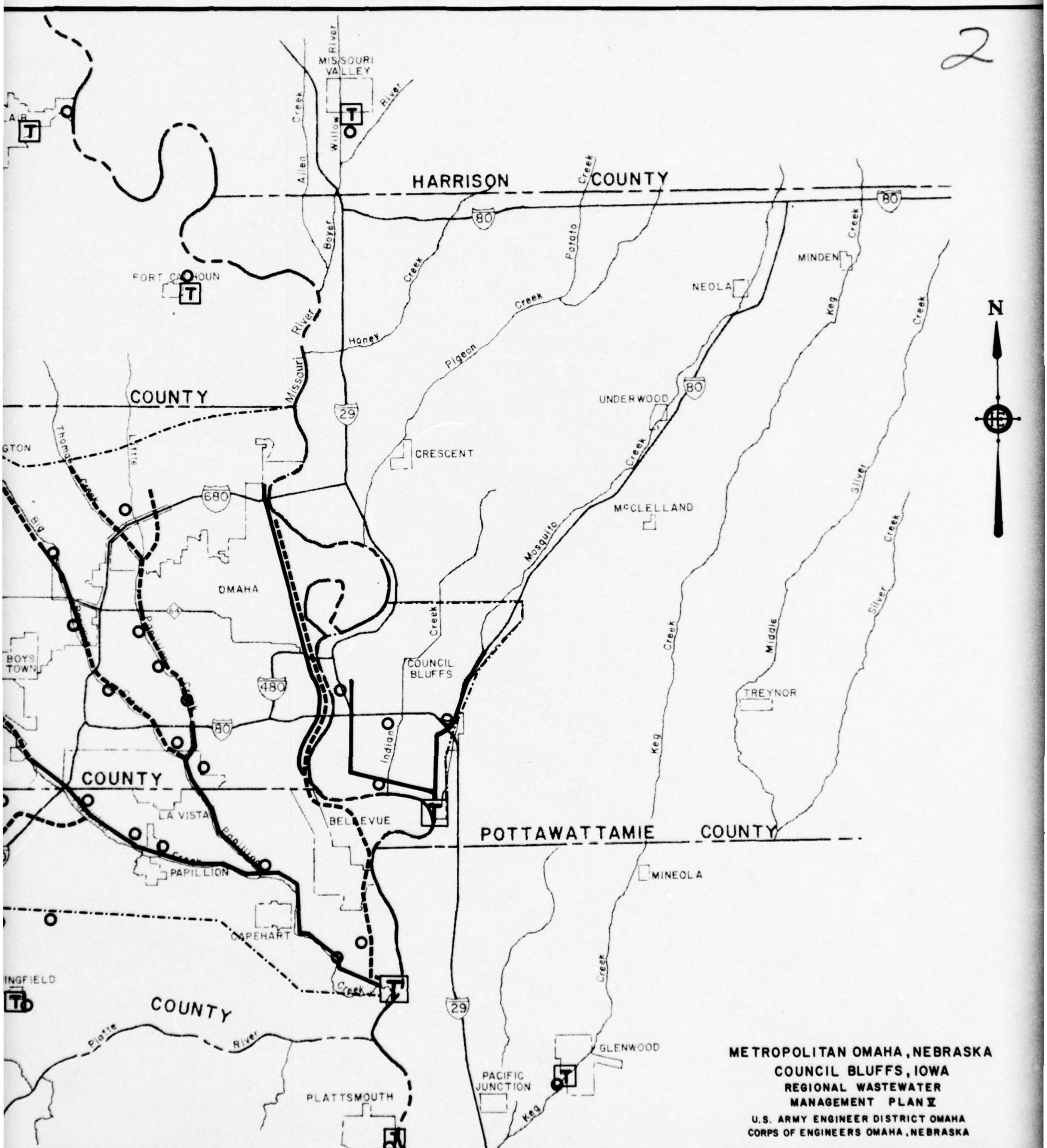
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY ○

TRANSMISSION FACILITIES

EXISTING ———

PROPOSED - - - - -





METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN V
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

1

LEGEND

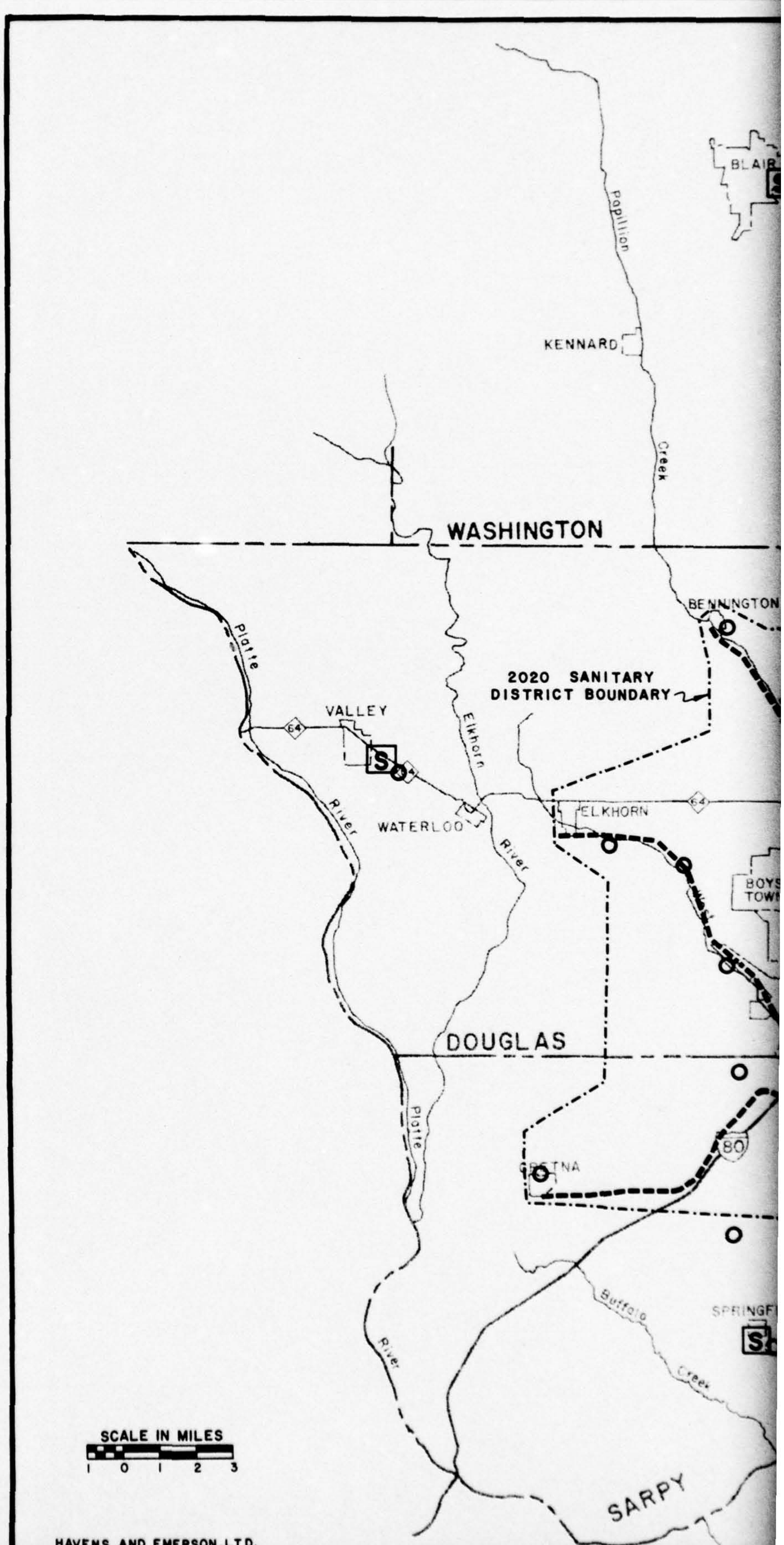
PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

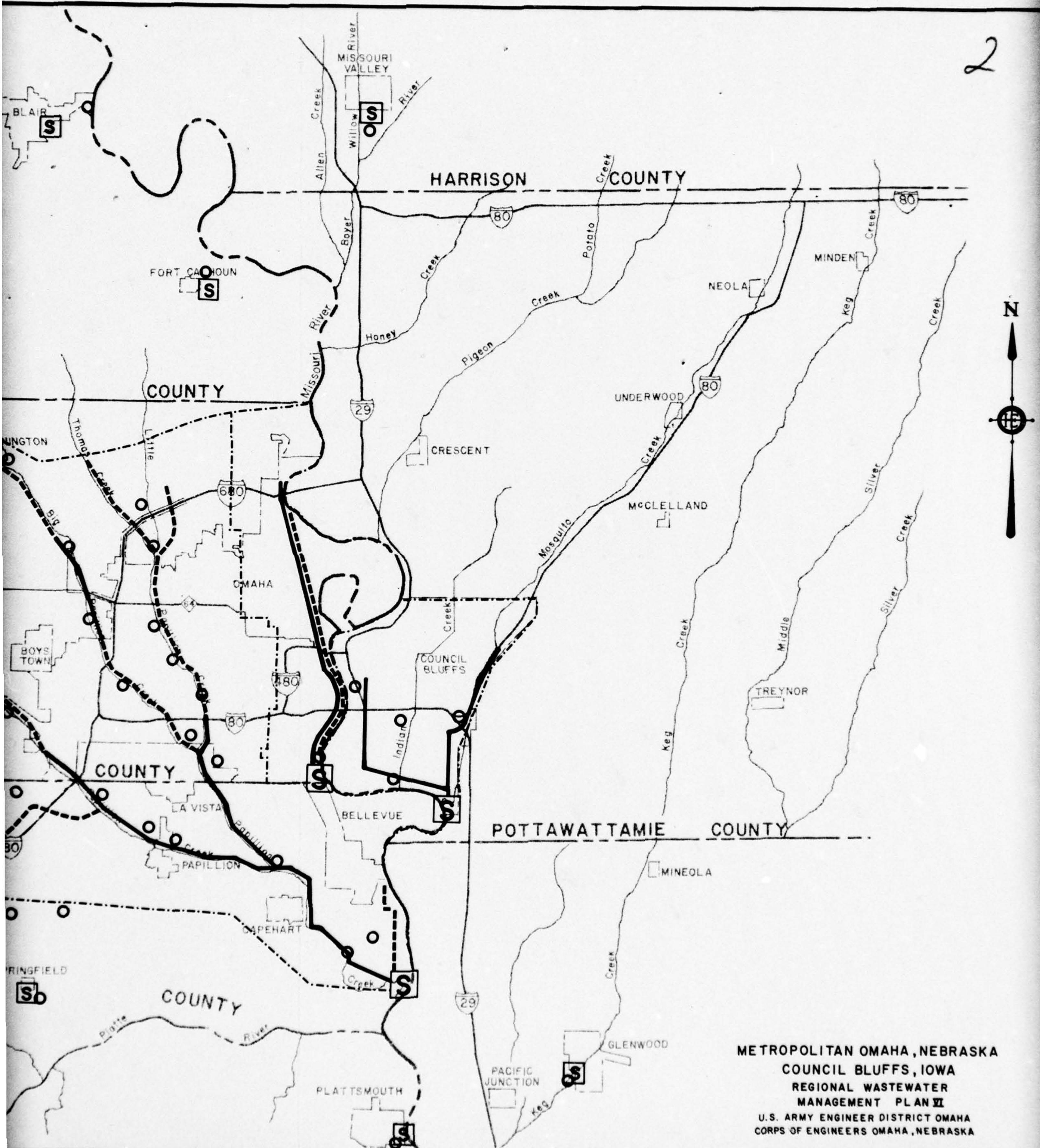
STORMWATER

TREATMENT AND DISCHARGE TO DESIGNATED GOAL ●
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY ○

TRANSMISSION FACILITIES

EXISTING ————
PROPOSED - - - - -



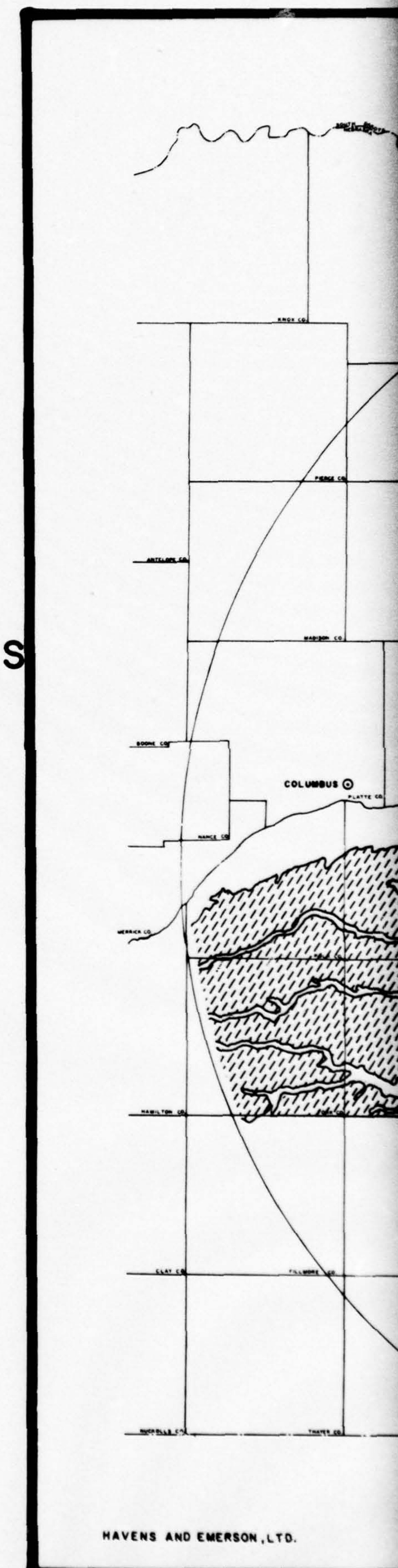


VOLUME III ANNEX B FIGURE E-

LEGEND

LAND TREATMENT PRIORITY OF SITES

- Nº1 23 AND 22 - Nebraska
- Nº2 29 AND 30 - Nebraska
- Nº3 21, 22 AND 26 - Nebraska
- Nº4 26 AND 29 - Iowa
- Nº5 6 AND 14 - Iowa
- Nº6 12, 18, 33 AND 34 - Iowa



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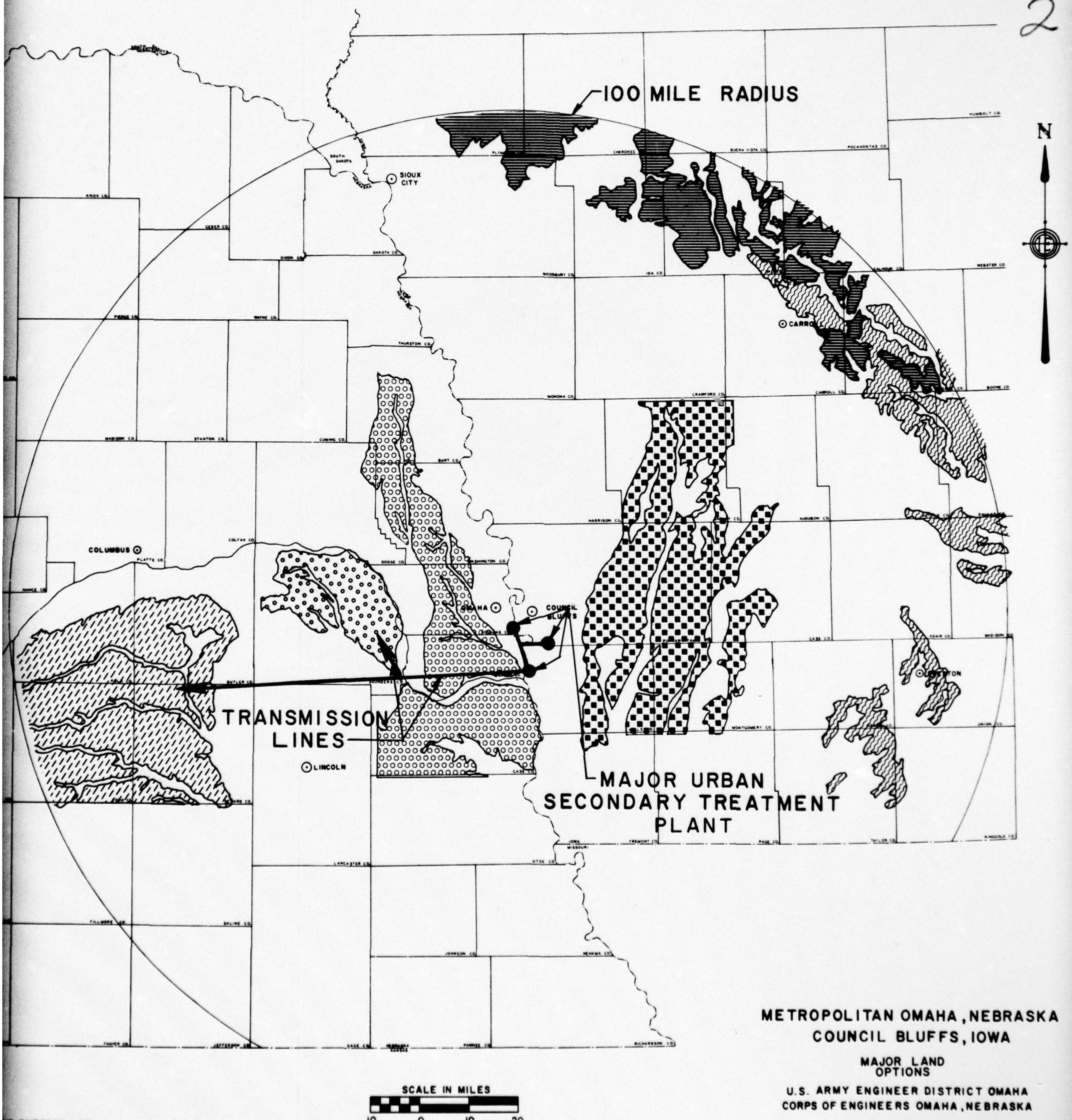


METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MAJOR LAND OPTIONS

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

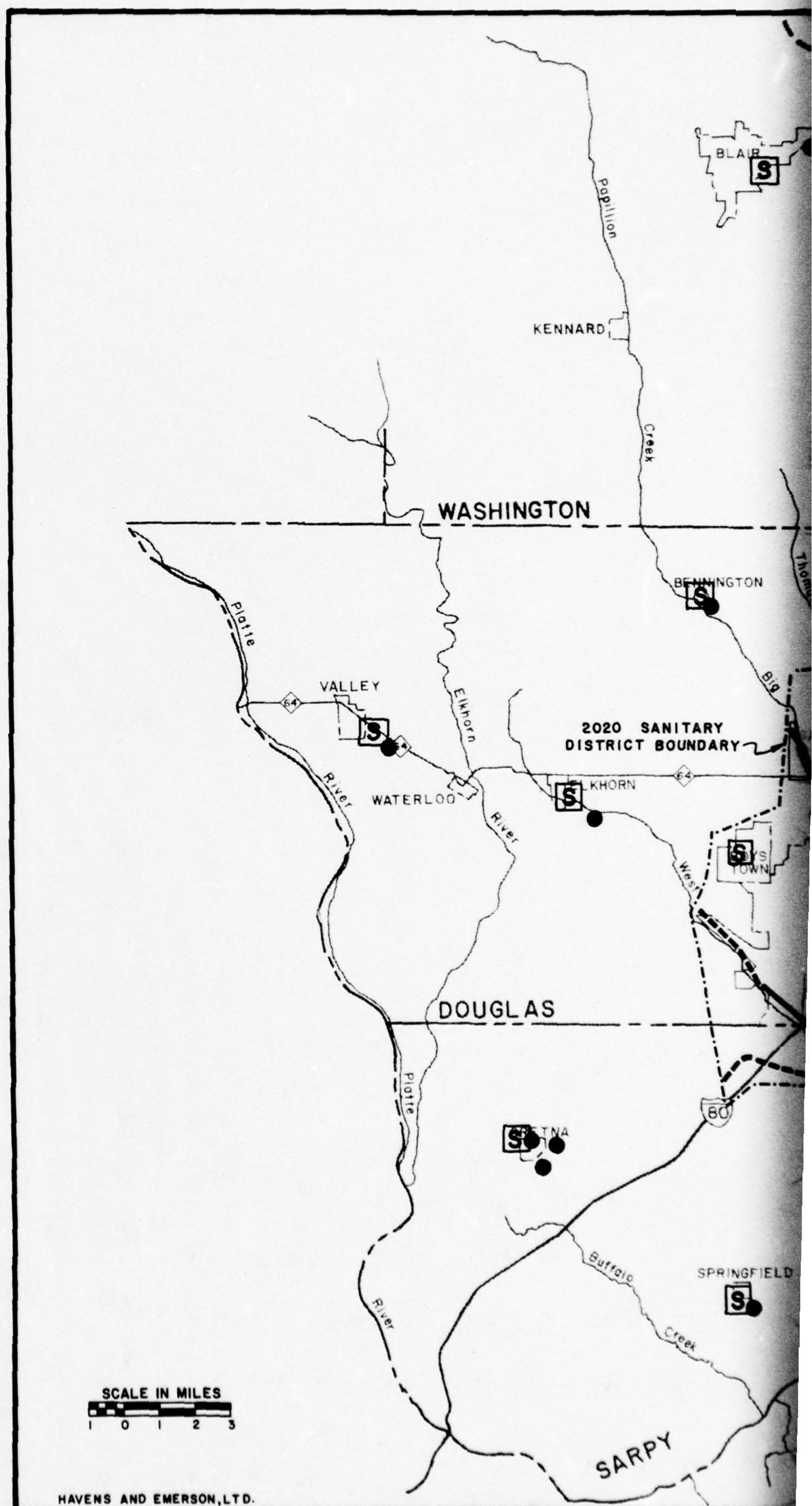
TREATMENT AND DISCHARGE TO DESIGNATED GOAL ●

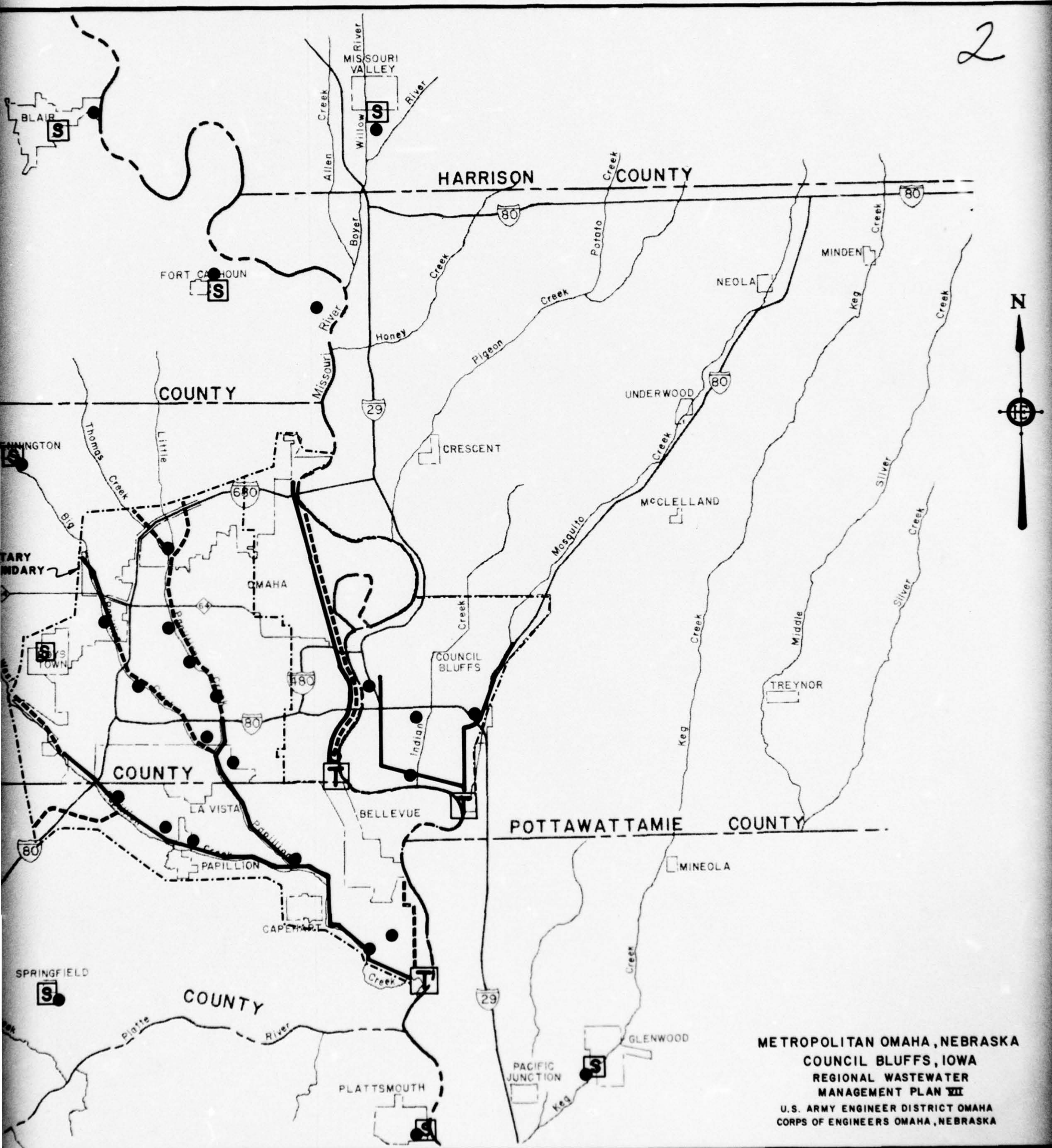
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY ○

TRANSMISSION FACILITIES

EXISTING

PROPOSED





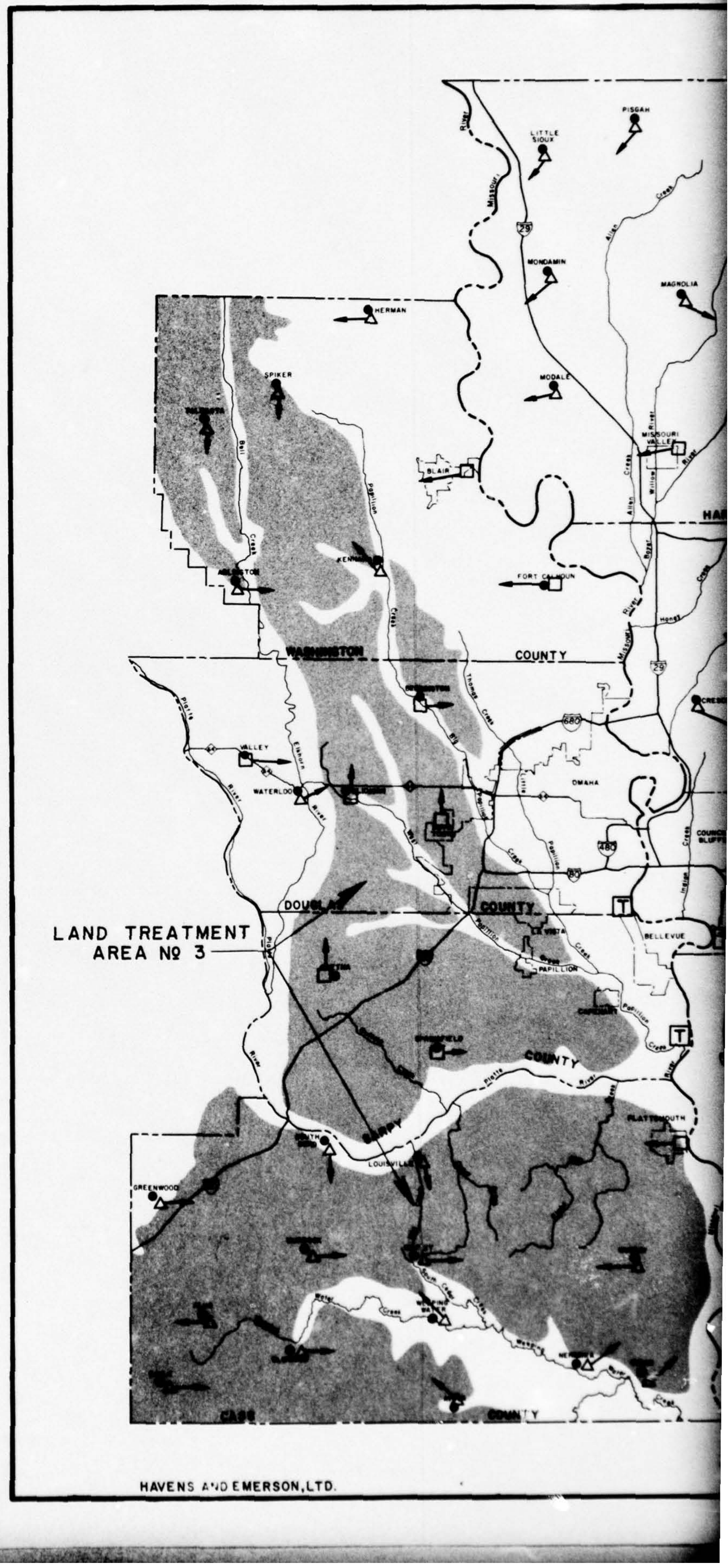
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN VII
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

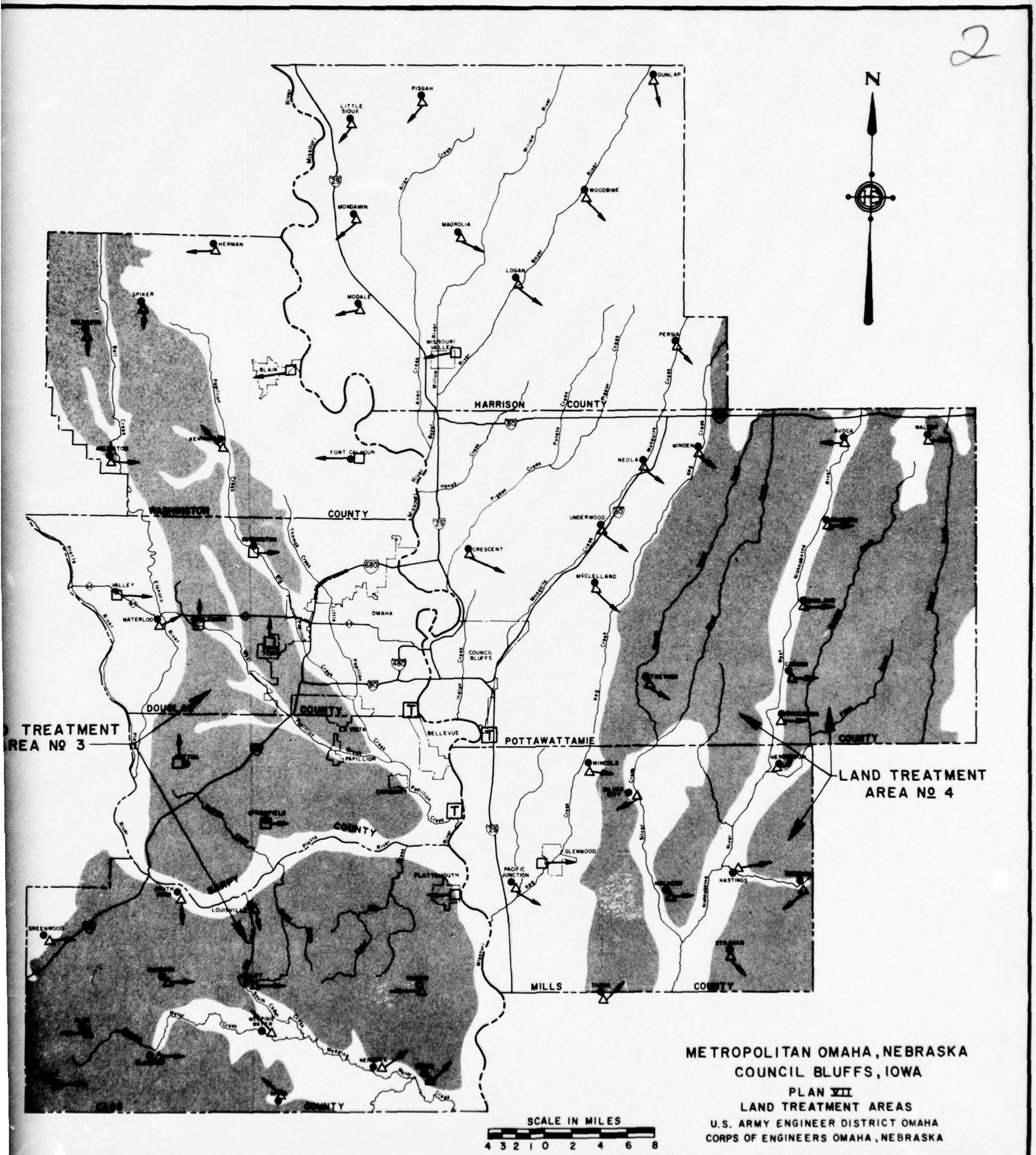
LEGEND

□ MINOR URBAN WASTEWATER TREATMENT PLANTS

T MAJOR URBAN WASTEWATER TREATMENT PLANTS

△ NON URBAN WASTEWATER TREATMET PLANTS





METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

PLAN VII
LAND TREATMENT AREAS

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

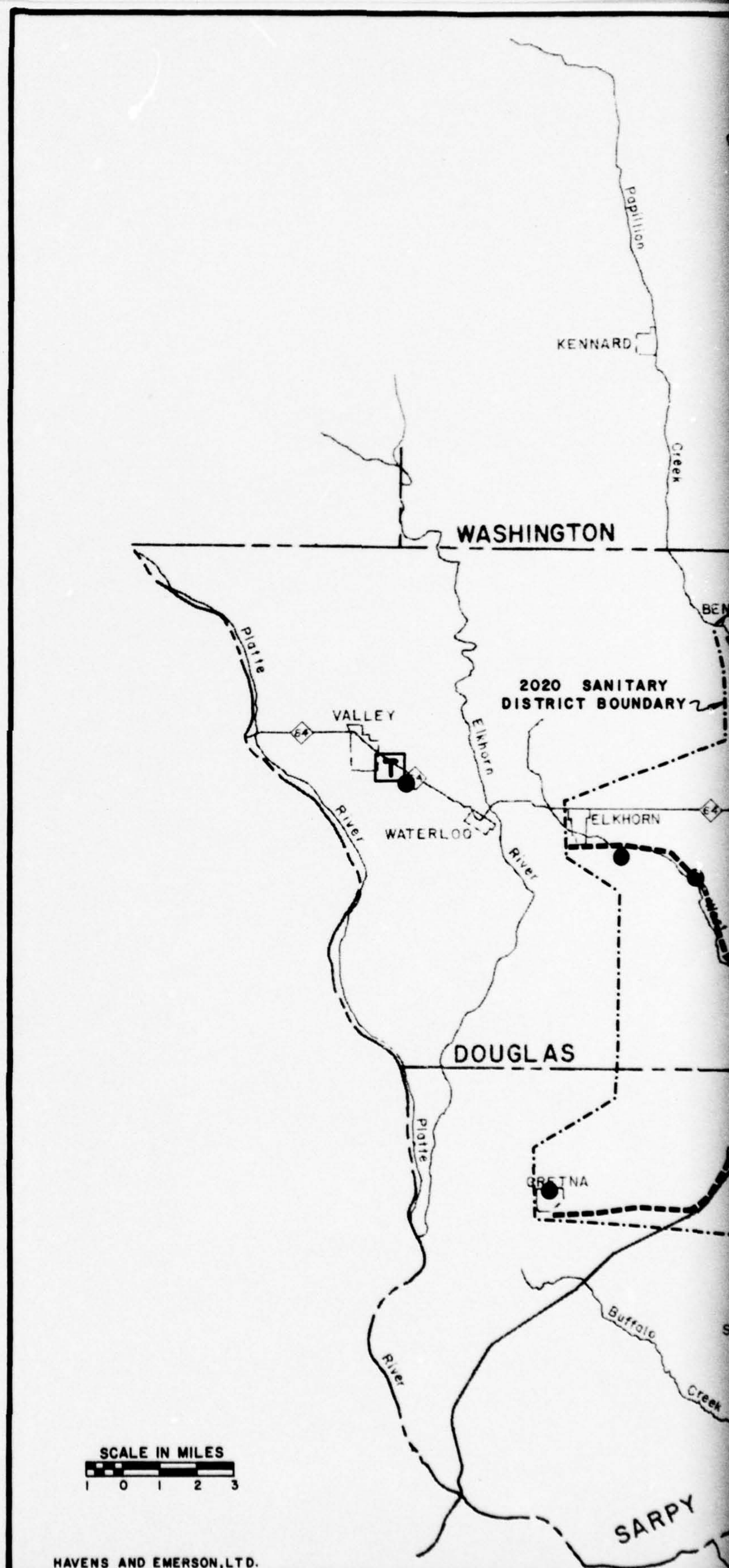
TREATMENT AND DISCHARGE TO DESIGNATED GOAL .... ●

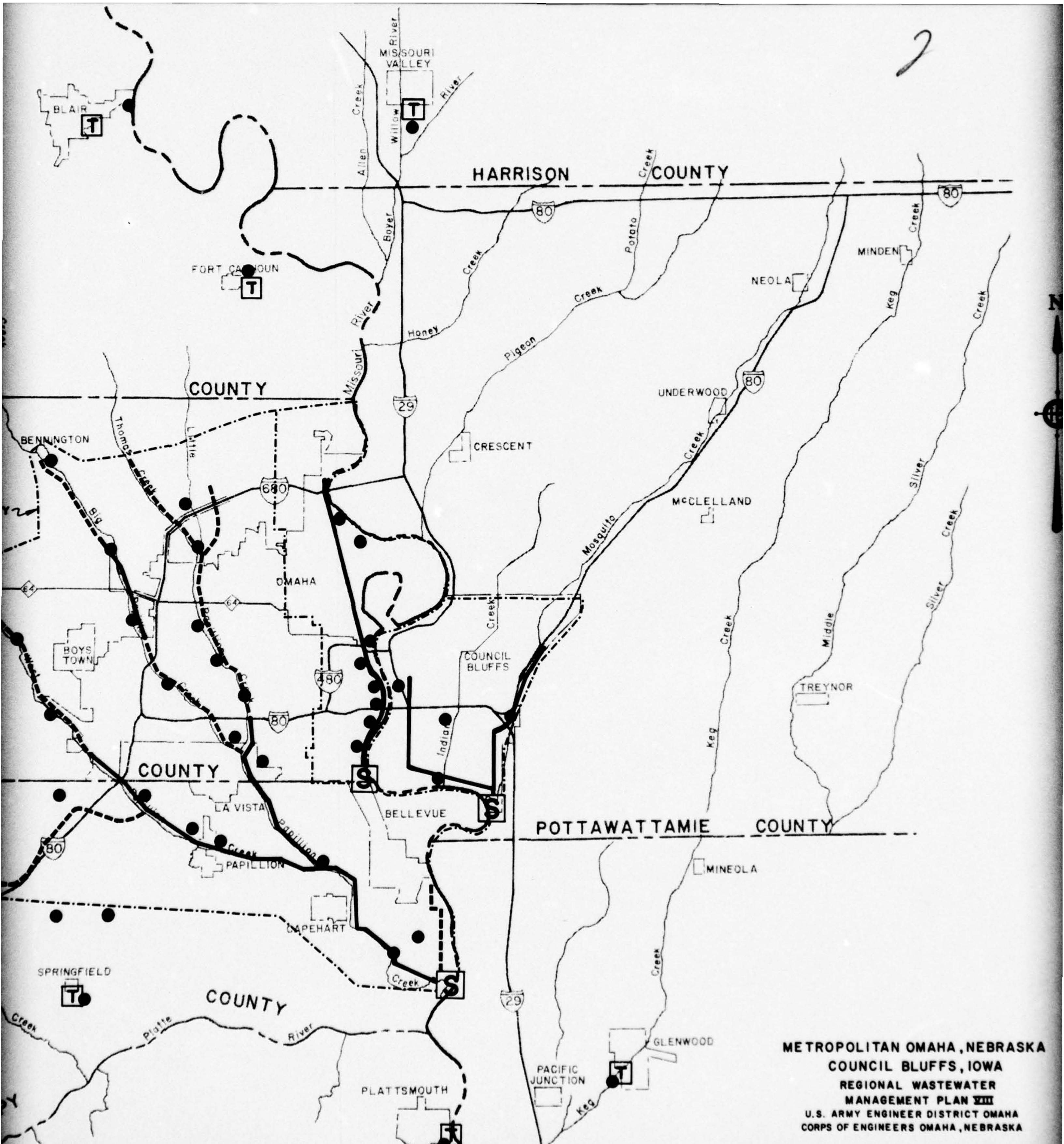
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY .... ○

TRANSMISSION FACILITIES

EXISTING .... ———

PROPOSED .... - - - - -





METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN VIII
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

VOLUME III ANNEX B FIGU

with their effluent transported to the western land sites. All stormwater is handled by individual system treatment plants.

89. This plan provides further insight into land treatment systems and provides the maximum nutrient value for amount of water transported to large distant sites.

EVALUATION

COSTS

90. Table E-9 shows the total present worth summaries for Plans I through VIII, with the variations due to the alternative futures (Concepts A, B, C, and D), level of treatment (1, 2, and 3), and design storms (1-, 5-, and 10-year).

91. A comparison of the variations with levels shows the general trend of increasing cost with the levels. The increase between Level 1 and Level 2 is caused primarily by the wastewater facilities. The stormwater and wastewater facilities cause the major increase from Levels 2 to 3. Plans III, V, and VI exhibit less increase between Levels 2 and 3 indicating that storage and conveyance of of stormwater becomes more cost-effective at higher levels. The variations with alternative futures are slight, with Concept C generally being the lowest in cost.

92. Comparisons of plan cost permit some preliminary judgments. Comparisons of Plans I and II indicate that the regionalization of the sewer system is cost effective although the cost difference is

Table E-9

TOTAL PRESENT WORTH SUMMARY
($ Million)

Component	Design Storm	Concept A Level 1	Concept A Level 2	Concept A Level 3	Concept B Level 1	Concept B Level 2	Concept B Level 3	Concept C Level 1	Concept C Level 2	Concept C Level 3	Concept D Level 1	Concept D Level 2	Concept D Level 3
(PLAN I)													
	Total 1 Year	584	661	781	600	684	803	563	640	758	580	656	785
	Total 5 Year	829	906	1,109	846	930	1,123	804	881	1,064	827	903	1,103
	Total 10 Year	971	1,048	1,305	973	1,057	1,268	936	1,013	1,215	963	1,039	1,297
(PLAN II)													
	Total 1 Year	585	664	795	603	694	815	562	642	762	581	660	790
	Total 5 Year	833	912	1,115	852	943	1,138	812	887	1,072	830	909	1,110
	Total 10 Year	975	1,054	1,300	979	1,070	1,283	939	1,019	1,223	966	1,045	1,304
(PLAN III)													
	Total 1 Year	670	747	788	666	750	784	625	702	739	665	741	781
	Total 5 Year	847	909	970	821	905	944	794	871	912	832	908	953
	Total 10 Year	986	1,063	1,113	932	1,016	1,057	930	1,007	1,050	948	1,024	1,073
(PLAN IV)													
	Total 1 Year	641	718	836	647	729	839	620	696	801	640	717	833
	Total 5 Year	897	974	1,164	902	984	1,168	870	946	1,116	896	973	1,160
	Total 10 Year	1,039	1,116	1,349	1,029	1,111	1,313	1,002	1,078	1,267	1,032	1,109	1,354
(PLAN V)													
	Total 1 Year	720	797	824	704	786	812	674	750	776	713	790	882
	Total 5 Year	895	972	1,006	860	942	971	848	924	949	880	957	990
	Total 10 Year	1,035	1,112	1,150	972	1,054	1,085	980	1,056	1,088	998	1,075	1,111
(PLAN VI)													
	Total 1 Year	670	1,065	1,077	666	1,038	1,047	625	995	1,004	665	1,074	1,085
	Total 5 Year	847	1,252	1,269	821	1,203	1,217	794	1,174	1,187	832	1,254	1,270
	Total 10 Year	986	1,404	1,425	932	1,319	1,335	930	1,315	1,330	948	1,377	1,397
(PLAN VII)													
	Total 1 Year	497	583	665	412	614	689	473	559	636	486	572	645
	Total 5 Year	679	765	901	693	795	921	649	735	853	676	762	895
	Total 10 Year	780	866	1,016	779	881	1,013	740	826	952	771	857	1,046
(PLAN VIII)													
	Total 1 Year	584	852	962	600	858	961	771	830	927	580	849	955
	Total 5 Year	840	1,108	1,290	855	1,113	1,290	1,021	1,080	1,242	836	1,105	1,282
	Total 10 Year	982	1,250	1,475	982	1,240	1,435	1,153	1,212	1,393	972	1,241	1,476

slight. Regionalization of treatment facilities by phasing out the Missouri River Plant is indicated to be more expensive by comparing Plans IV and I. Conveyance of stormwater to the municipal plant is shown by comparing Plans I and III and Plans IV and V. Conveyance is generally higher is cost than upsystem treatment in both comparisons although the difference is slight in the higher levels. Level 3 costs in Plans IV and V indicate conveyance is less costly. The Level 1 costs for Plans II and VII indicate that the handling of stormwater by tunnel in the Missouri River District is less costly than the storage and treatment concept used in Plan II. The land treatment Plans VI, VII, and VIII indicate that handling stormwater in land systems is more expensive than separate stormwater treatment.

COST EFFECTIVENESS

93. Cost comparisons were conducted for treatment level effectiveness of removal of suspended solids, BOD, phosphorous, and nitrogen. Figure E-14 is a summation of these four comparisons, weighing each pollutant parameter equally. The curves indicate that treatment of wastewater to higher levels is more cost effective than higher levels of stormwater treatment.

94. The cost increases for stormwater treatment are illustrated for the different design storms in figure E-15. This figure illustrates the decrease in cost effectiveness as the design storm facilities are increased from the 1- to the 5- to the 10-year design storm. The relatively slight increase in total suspended solids removed results in a considerable increase in costs. The 1-year storm is therefore suggested as the maximum recurrence interval which should be considered for stormwater

facility design. This also applies to combined sewer overflows.

95. The impacts of design storms and treatment levels for stormwater treatment on water quality were analyzed for the Papillion Creek system. Figure E-16 shows the water quality effect of no stormwater treatment versus Level 1 treatment of the 1-year storm.

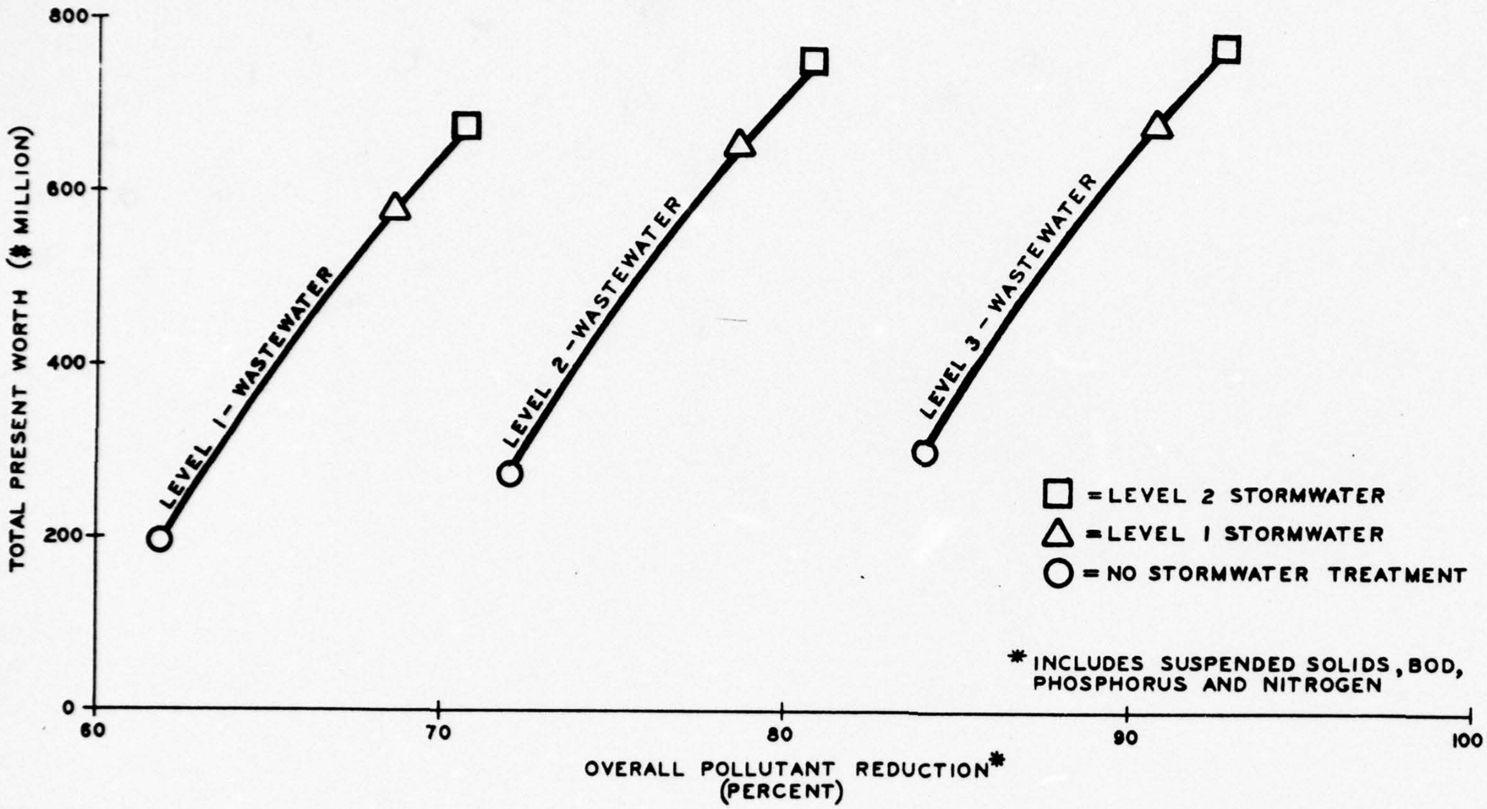
96. Based on the above, conveyance of stormwater is not cost-effective. In addition, the Omaha Public Works Department favored upstream treatment and discharge for separate stormwater but preferred conveyance for the combined sewer overflows. The above factors eliminated Plans III, V, and VI from further consideration.

REGIONALIZATION

97. The difference between Plan I and IV is in the regionalization of the Omaha-Missouri River plant to the Papillion Creek plant. Table E-10 shows a comparison of present worths for separate plant versus combined plants. The combined cost of the Papillion plant includes the transmission facilities. The analysis indicates the separate scheme to be slightly less expensive than the combined scheme.

98. Missouri River water quality modeling indicates that the large, one-plant discharge would have more impact on the river than the two-plant discharge.

99. For the above reasons, Plan IV was excluded from further consideration.

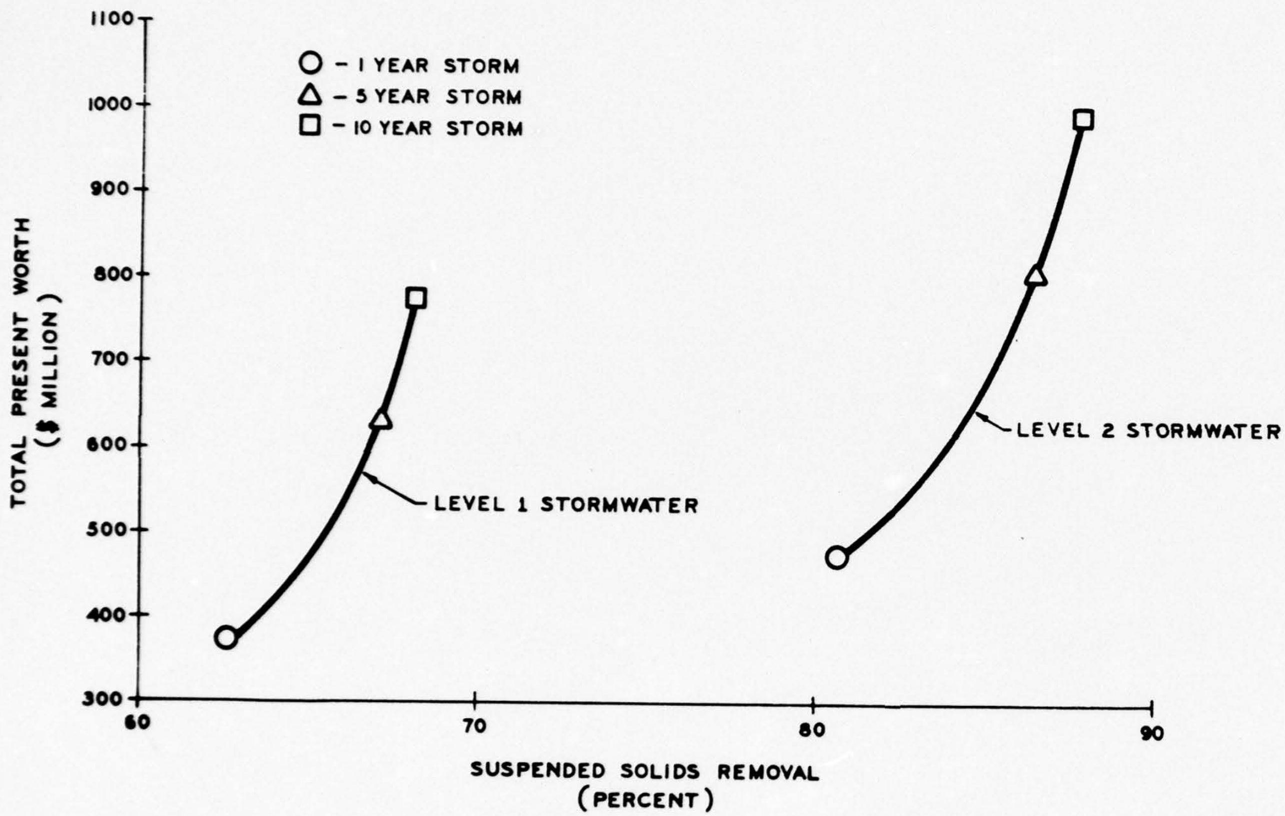


METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

COST EFFECTIVESS

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

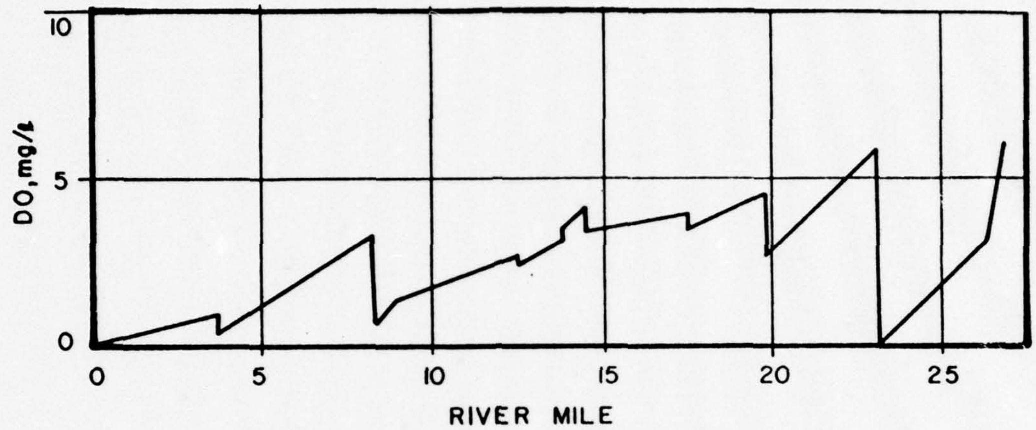
JUNE 1975



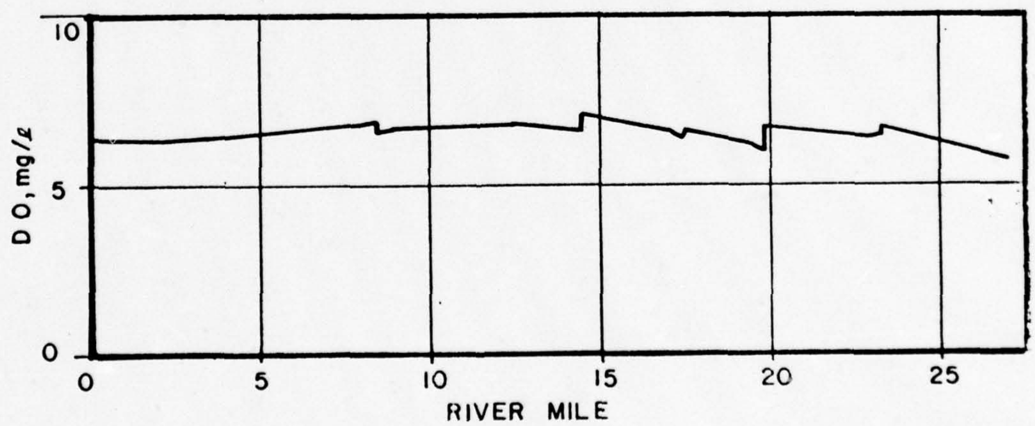
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

COST EFFECTIVESS

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975



RIVER MILE vs
QUALITY AND FLOW
NO TREATMENT



RIVER MILE vs
QUALITY AND FLOW

I YEAR STORM

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
BIG PAPILLION CREEK
NO TREATMENT VS.
ONE YEAR STORM TREATMENT

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

Table E-10
TWO PLANTS VS. ONE PLANT
PRESENT WORTH
($1,000)

Separate Plants	CAP.		O&M
Papillion	$32,947		$30,825
Missouri River	39,317		30,360
TOTAL	$72,464		$61,185
GRAND TOTAL		$133,649	
Combined Plants			
Papillion	$72,675		$55,416
Missouri River (Pretreatment)	0		8,994
TOTAL	$72,675		$64,410
GRAND TOTAL		$137,085	

100. Considerable effort has been put into various studies on determination of the cost-effectiveness of extending the Papillion Creek sewer system to include the Bellevue No. 1 wastewater treatment plant. Table E-11 illustrates the final cost comparisons of these studies. The MAPA report and the Havens and Emerson report show a slight economic benefit (less than 1 percent) towards the abandonment of the Bellevue No. 1 plant. The Kirkham-Michael report, however, shows a slight economic benefit (less than 0.1 percent) towards maintaining the Bellevue No. 1 plant. The result of all these studies is that the costs are essentially equivalent on a regional basis and therefore the decision may be based on other considerations.

WATER QUALITY IMPACTS

101. Stream modeling was conducted for the Missouri River, Little Papillion Creek, Big Papillion Creek, and West Papillion Creek with dissolved oxygen (DO) being the standard analyzed. A detailed description of the modeling is contained in the Phase II report by Havens and Emerson. The conclusions are described in the following paragraphs.

102. Based on past records, the Missouri River flow is at a minimum in the winter and reaches its high in the summer. Using this as a base, the curves presented show that the water quality standard for DO will be met at low flow and low temperature, or at high flow and high temperature for Level 1 wastewater treatment quality and Level 1 stormwater quality providing that a single discharge of the Omaha-Missouri River overflows is incorporated.

Table E-11

BELLEVUE COST COMPARISONS

	(1) Maintain Bellevue	(2) Bellevue to Papillion	Percent Difference $[\frac{(1)-(2)}{(1)}] \times 100$
MAPA* ($1000/Year)	4,656	4,611	0.97
Kirkham-Michael** (Dollars/Year)	10,094,178	10,103,054	-0.09
Phase I*** (Present Worth - $1000)	73,322	72,720	0.82

*MAPA, Wastewater Collection and Treatment, June, 1972.
**Kirkham-Michael, Supplement III, Wastewater Treatment Plant No. 1 for Bellevue, Nebraska, March, 1974.
***Havens and Emerson, Ltd., Phase I, Omaha-Council Bluffs. Wastewater Management Study, October, 1974.

103. If current planning continues toward upstream diversions of Missouri River water in the summer, then a low flow-high temperature situation could control. Under this combination, the curves indicate that effluent quality requirements for wastewater and stormwater must be increased to Level 2 for both, using a single stormwater discharge concept for the Omaha-Missouri River overflows. Higher levels would be required using a multiple discharge (New Alternative 1) for the Omaha-Missouri River overflows.

104. The figures concerning wastewater discharges at low-flow conditions in the Papillion Creek show that Level 2 wastewater treatment for the communities of Elkhorn and Bennington is required to maintain the DO standard. A slight contravention of standards occurs for Elkhorn even with Level 2 wastewater, but this is uncertain pending verification of the model and is not considered serious. The Nebraska Natural Resources Commission has verified these conclusions using an ammonia toxicity standard. Removal of ammonia would require Level 2 treatment for Elkhorn and Bennington.

105. It should be noted that these conclusions are based on a preliminary modeling of the Missouri River, limited to the reach downstream of Blair, and made upon simplifying assumptions as to water quality entering the reach. These results should be verified by more detailed modeling studies of the entire river before final commitment of plan implementation is made.

SECTION F

PLANS SELECTED FOR FURTHER CONSIDERATION

PLANS SELECTED FOR FURTHER CONSIDERATION

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TABLE OF CONTENTS (Cont'd)

LIST OF FIGURES (Cont'd)

SECTION F

PLANS SELECTED FOR FURTHER CONSIDERATION

Consideraitons

1. After consideration of the findings of the analysis of the eight initial alternatives, guidelines were developed for the final alternatives:

- Conveyance of all stormwater to municipal plants should not be considered as a full alternate.

- Handling of stormwater by land treatment was eliminated as not cost-effective.

- Three major urban plants would remain.

- Bellevue would be incorporated into the Papillion STP, although it would be cost effective to remain independent.

- Continue consideration of all four growth concepts.

- Analyze conveyance for combined sewer areas.

- Retain a land treatment plan.

- Consider winter irrigation from the major urban plants to avoid winter storage and pumping.

- Meet water quality even if more than secondary treatment is required.

- Use the 1-year design storm in the design of all stormwater handling facilities.

- Give consideration to sewer system improvements.

- Continue consideration of three treatment levels for wastewater and two for stormwater, but give emphasis to lower levels.

2. Following review of the initial plans by Federal, State, and local agencies, three basic plans were selected with several options under each for wastewater, combined overflow, and stormwater management. The three basic plans are discussed first and then the options within the areawide plans.

Areawide Plan Descriptions

3. Three full alternative plans and a major land treatment option are developed based on the results of initial plan analysis.

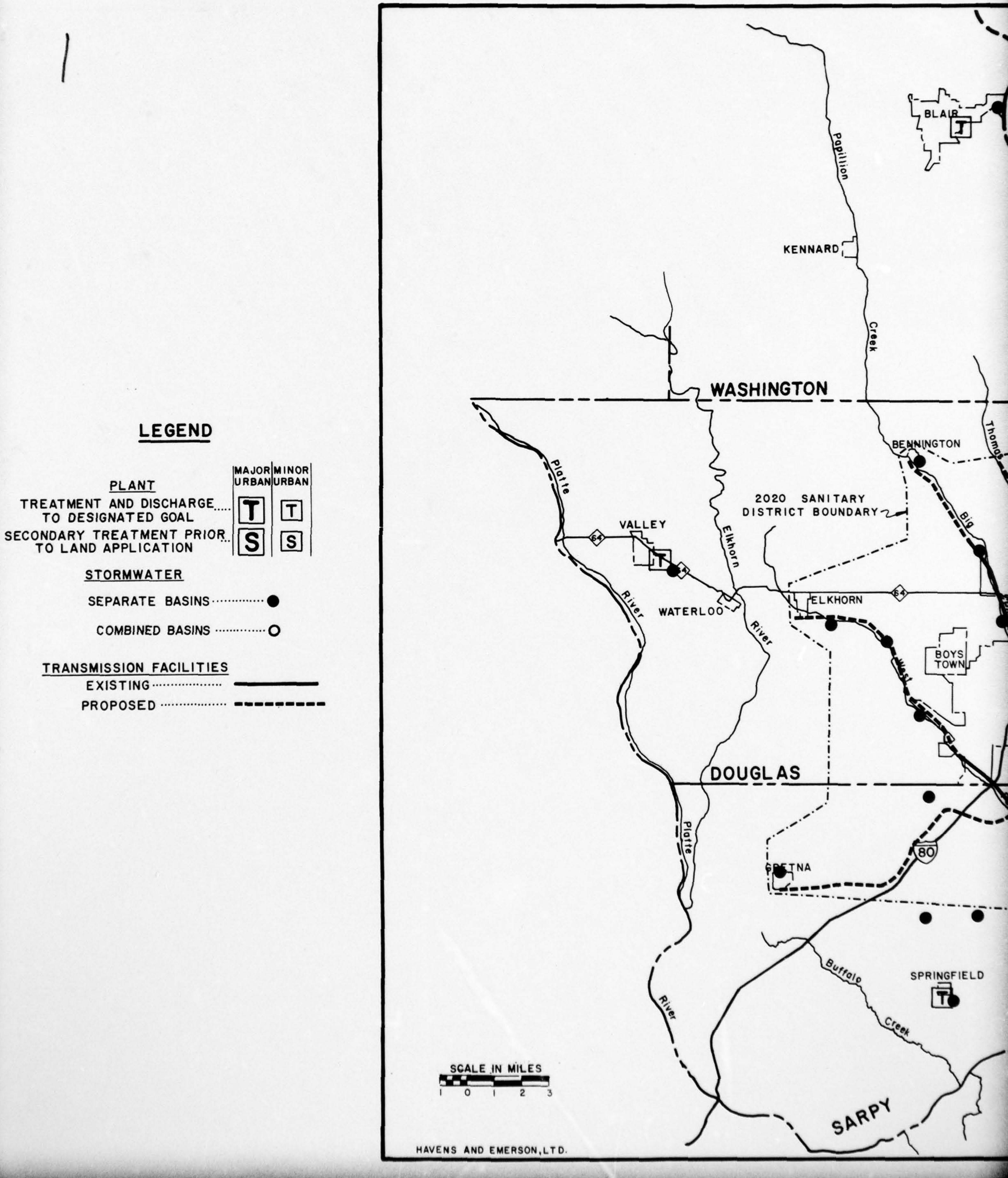
4. The three plans basically follow the wastewater layout for the lowest cost plans presented in initial Plan I, Plan II, and Plan VII. Stormwater collection and treatment are accomplished the same for each plan, but both upsystem treatment and conveyance to the municipal plant for treatment are used within the refined plans. For all areawide plans, any of the alternatives for the Missouri combined sewer overflows are applicable. Upsystem treatment is used in the remainder of the basins although a sub-alternative is presented for conveyance of two combined sewer areas in the Papillion Basin and one combined sewer area in Council Bluffs to the municipal wastewater treatment plants. Each plan is costed for the 1-year design storm and all treatment levels. Level 1 stormwater is associated with both Level 1 and Level 2 wastewater, and Level 2 stormwater is associated with Level 3 wastewater.

5. The major land option is developed to analyze the possibilities of using the urban wastewater effluent during the summer months in the large agricultural areas west of the study area. Several sub-options are considered using different treatment sites and flows. The major land option can be applied to any of the plans

but the concept conforms more closely to Plan 3 which envisions small land systems for the minor and non-urban facilities.

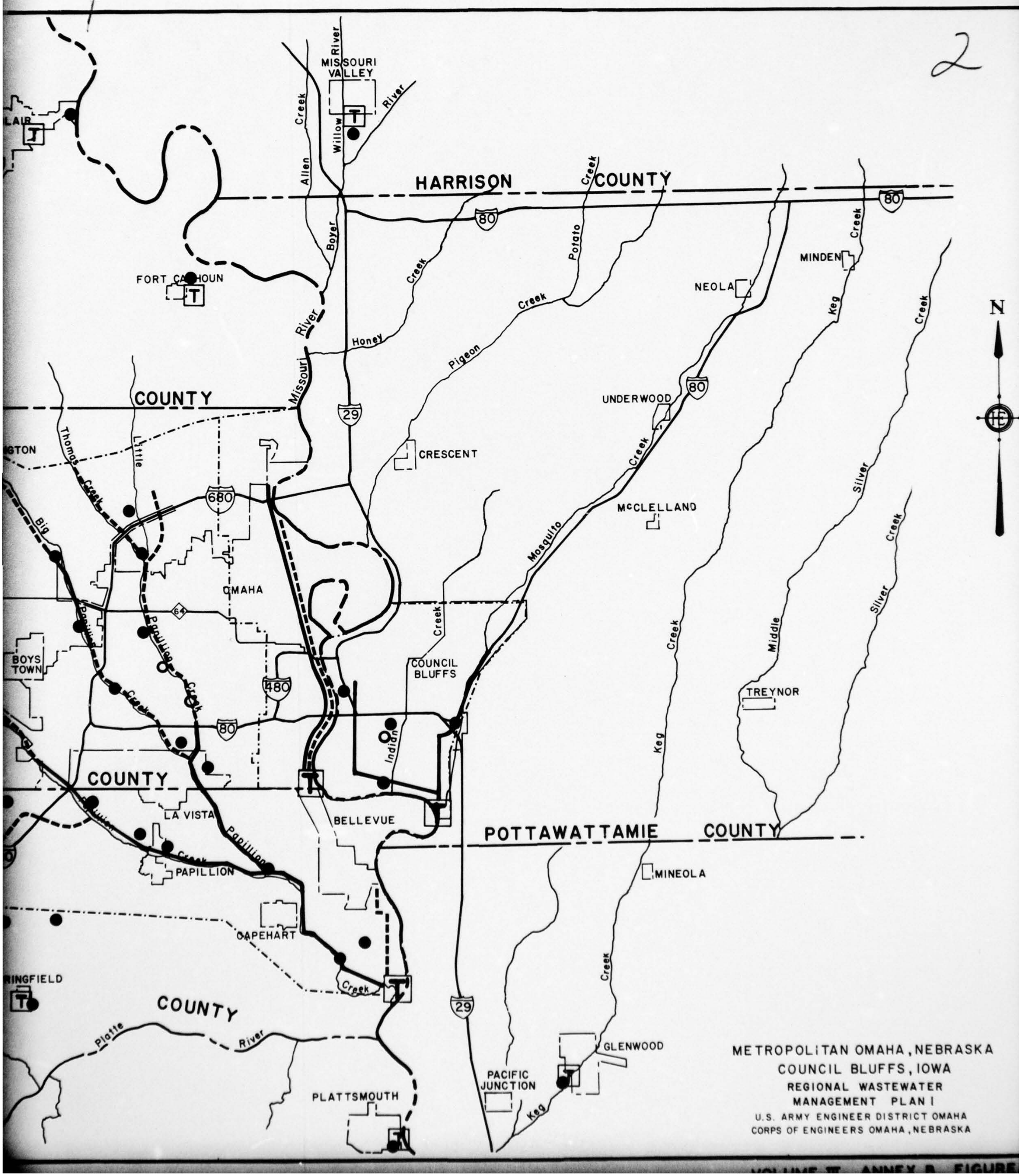
PLAN 1

6. Plan 1 is depicted in figure F-1. The wastewater system follows the concept developed in the MAPA studies with regionalization of the basin wastewaters to three major plants: Council Bluffs (Mosquito Creek), Missouri River, and Papillion. The Papillion sewer system is extended to include the communities of Bennington, Elkhorn, and Gretna. The stormwater management system varies with each basin. The combined overflows from the Omaha-Missouri River area (for a 1-year storm) are collected, stored, and treated at the Missouri River Treatment Plant by use of any one of four alternatives. In the Papillion and Council Bluffs basins, the 1-year storm is treated and discharged at various upstream locations. A sub-option is presented for collection, storage and conveyance of combined sewer basins to the Papillion Creek and Council Bluffs Treatment Plants. This includes two locations in the Papillion basin and one in the Council Bluffs area. Additional treatment units are required at the Papillion plant, but not at the Council Bluffs plant. Generally, Level 1 stormwater treatment is required at all basins. If, however, future Missouri River low flows are drastically reduced in the summer, Level 2 treatment may become necessary in the Papillion basin.



LEGEND
PLANT
MAJOR URBAN
MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION
S
STORMWATER
SEPARATE BASINS
COMBINED BASINS
TRANSMISSION FACILITIES
EXISTING
PROPOSED
BLAIR
Papillion
KENNARD
Creek
WASHINGTON
BENNINGTON
Thomas
Big
2020 SANITARY DISTRICT BOUNDARY
Platte
VALLEY
64
Elkhorn
River
WATERLOO
ELKHORN
BOYS TOWN
West
DOUGLAS
80
GRETNA
Buffalo
Creek
SPRINGFIELD
SCALE IN MILES
1 0 1 2 3
SARPY
HAVENS AND EMERSON, LTD.

2



VOLUME II ANNEX B FIGURE

AD-A041 923 ARMY ENGINEER DISTRICT OMAHA NEBR F/G 8/6
WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY. VOLUME III. --ETC(U)
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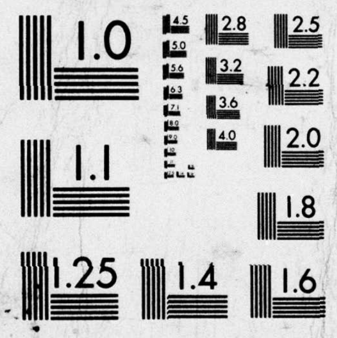


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

PLAN 2

7. Plan 2 depicted in figure F-2, generally follows current wastewater management planning by regionalizing to three major urban plants, except that the extent of the Papillion service district is reduced from Plan 1. The outer basin communities of Bennington, Elkhorn, and Gretna are not incorporated into the Papillion sewer district but remain as independent sub-districts. Level 2 wastewater treatment would be required for these three communities.

8. The stormwater management is identical with that in Plan 1. with Level 1 treatment and discharge of the 1-year storm at upsystem locations. The Missouri River combined overflows are stored and treated at a single location. Additional treatment and the possibility of conveyance of Papillion and Council Bluffs combined sewer overflows for treatment at municipal treatment plants are considered.

PLAN 3

9. Figures F-3 and F-4 illustrate Plan 3 components. The non-urban and minor urban plants will provide secondary treatment, with effluent applied to local land treatment facilities. The three major urban plants are designed to treat by conventional methods to the required treatment levels before discharge to the Missouri River. The stormwater system and sewer system layout are identical to Plan 2.

10. Generally, lands possessing adequate land treatment capabilities are located close to all minor and non-urban communities. An average transmission distance of 1.5 miles was assumed for costing purposes.

11. Plan 3 would annually recycle 12,000 acre-feet of treated effluents containing a total of 400 tons of nitrogen and 120 tons of phosphorous.

12. The quality of wastewater to be applied, assuming secondary pre-treatment, is indicated in table F-1.

13. The amount of irrigated land and land for storage requirements for each of the non-urban communities is indicated in table F-2 and for each of the minor urban communities in table F-3. The irrigated land requirements are based on an application rate of 33 inches per year. Lesser application rates would require proportionately more area.

LEGEND

PLANT	MAJOR URBAN	MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL	T	T
SECONDARY TREATMENT PRIOR TO LAND APPLICATION	S	S

STORMWATER

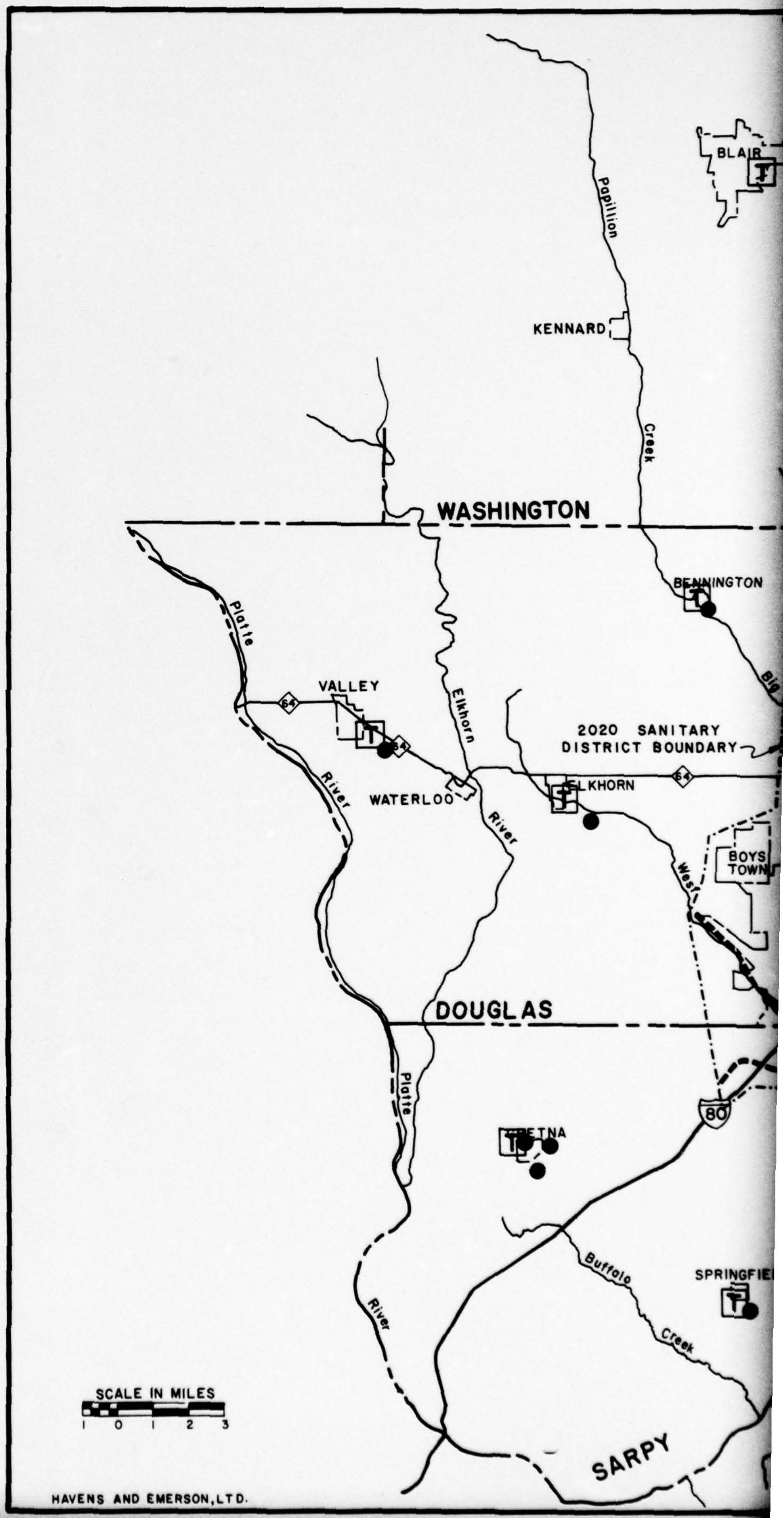
SEPARATE BASINS ●

COMBINED BASINS ○

TRANSMISSION FACILITIES

EXISTING

PROPOSED



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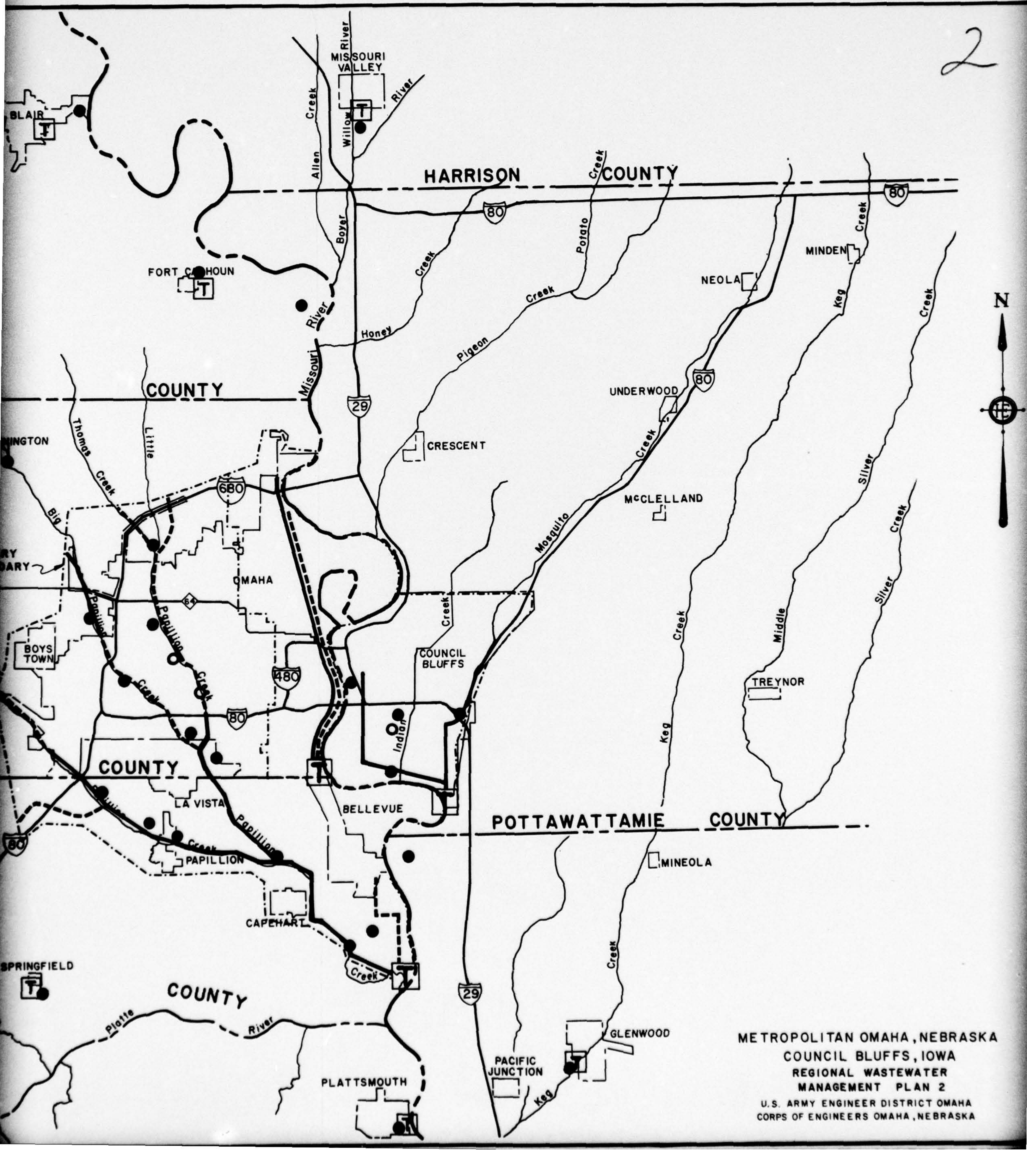
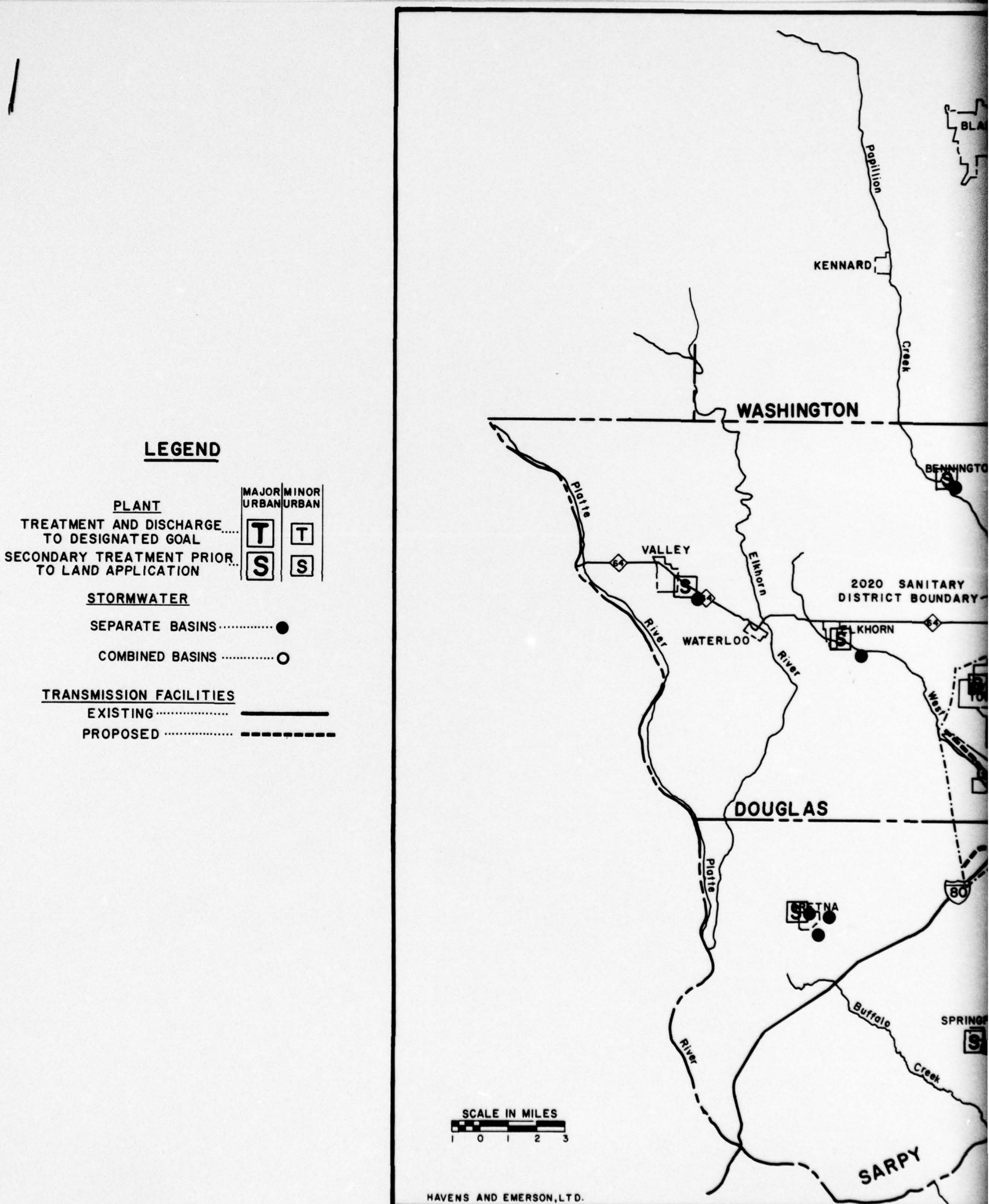
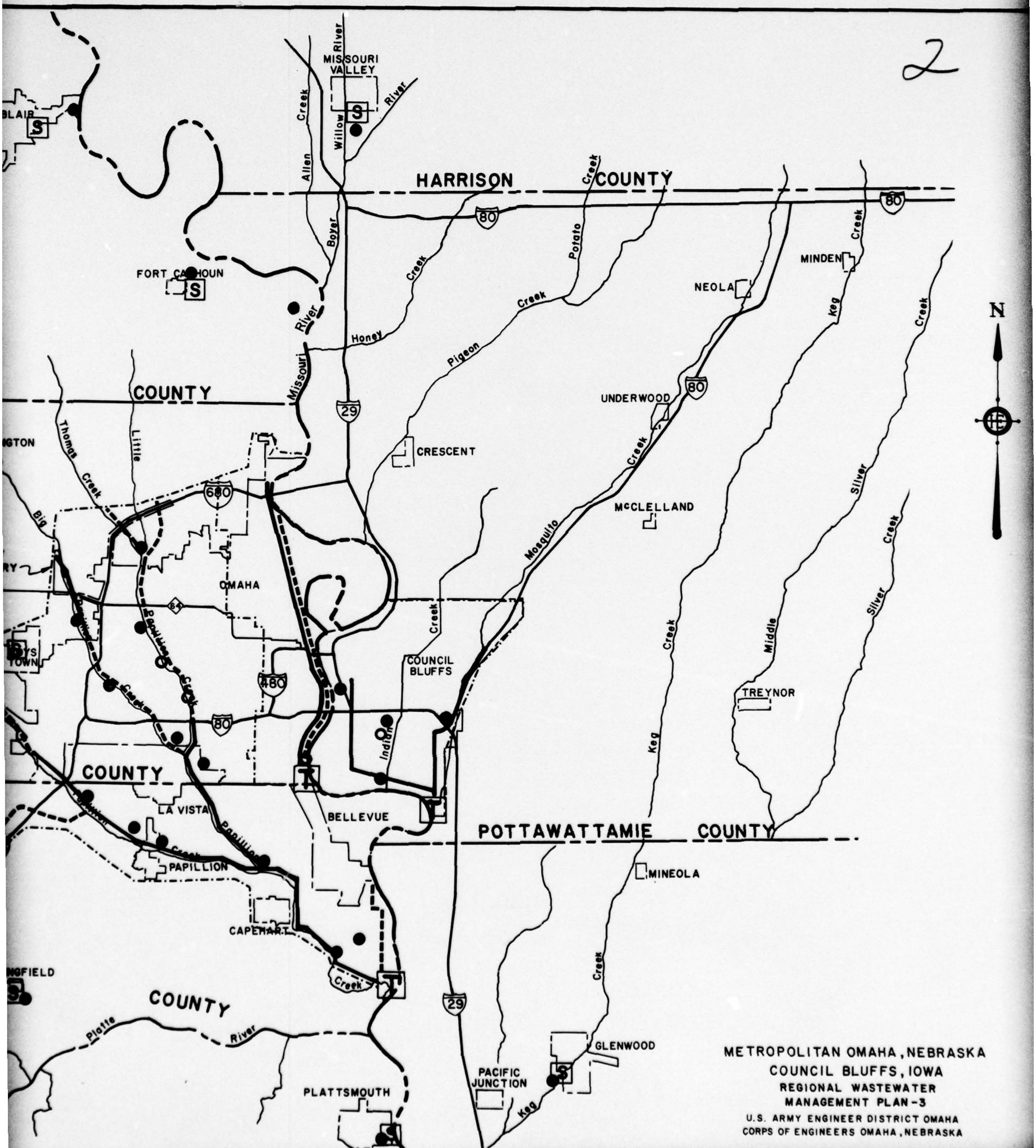


METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN 2
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

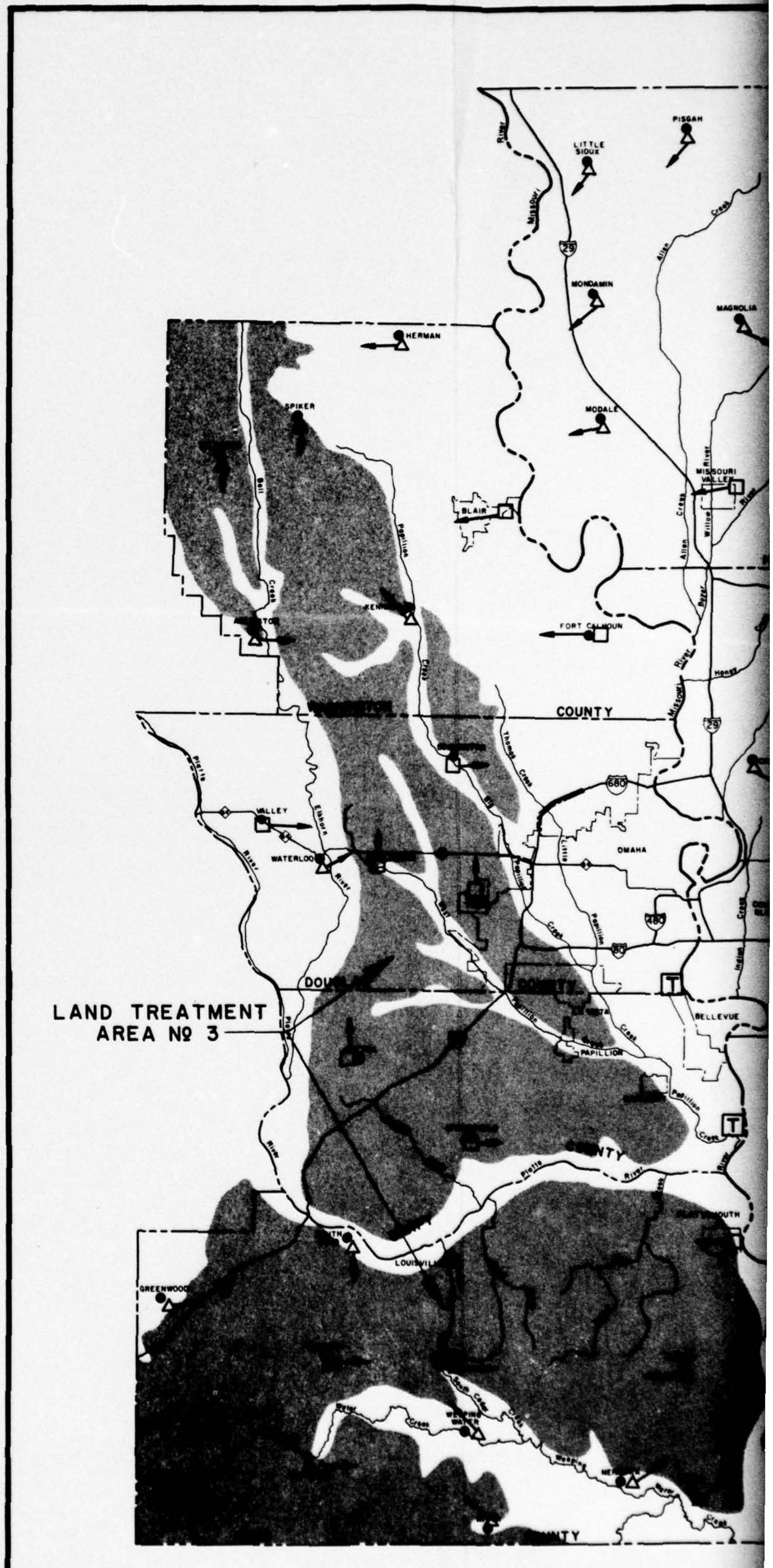

LEGEND
PLANT
MAJOR URBAN
MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
SECONDARY TREATMENT PRIOR TO LAND APPLICATION
STORMWATER
SEPARATE BASINS
COMBINED BASINS
TRANSMISSION FACILITIES
EXISTING
PROPOSED
Papillion
KENNARD
Creek
WASHINGTON
Platte
VALLEY
Elkhorn
2020 SANITARY DISTRICT BOUNDARY
River
WATERLOO
ELKHORN
DOUGLAS
Platte
80
Buffalo
Creek
River
SARPY
SCALE IN MILES
1 0 1 2 3
HAVENS AND EMERSON, LTD.

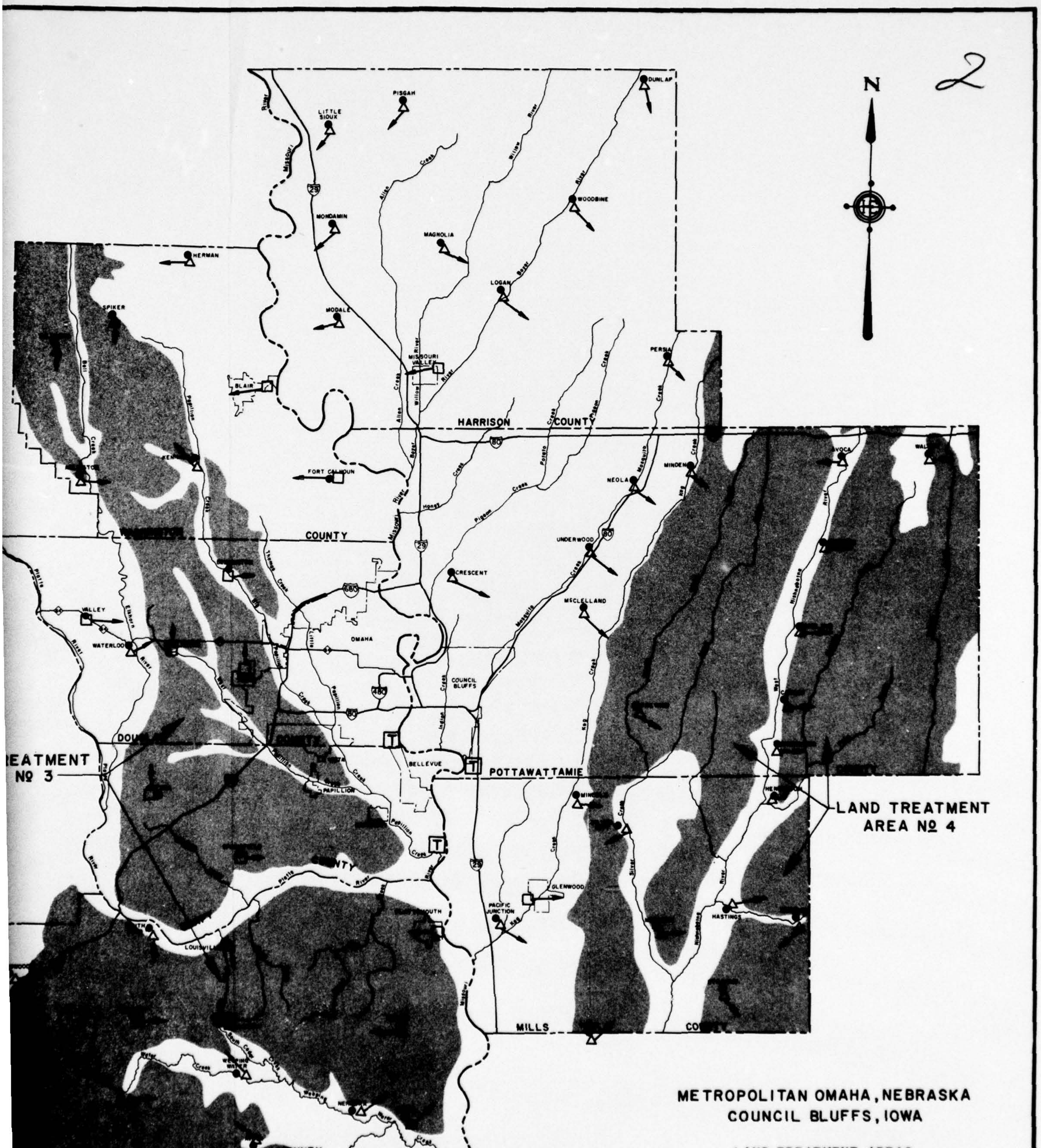


2
MISSOURI VALLEY
BLAIR
Allen Creek
Willow River
Boyer River
HARRISON COUNTY
80
FORT CALHOUN
Missouri River
Honey Creek
Pigeon Creek
Potato Creek
MINDEN
NEOLA
Keg Creek
N
COUNTY
29
UNDERWOOD
Thomas Creek
Little
CRESCENT
Big
680
McCLELLAND
Mosquito Creek
Silver Creek
OMAHA
64
Papillion Creek
Indian Creek
COUNCIL BLUFFS
Middle Silver Creek
BOYS TOWN
480
TREYNOR
COUNTY
LA VISTA
BELLEVUE
POTTAWATTAMIE COUNTY
PAPILLION
MINEOLA
CAPEHART
Creek
COUNTY
Platte River
GLENWOOD
PACIFIC JUNCTION
PLATTSMOUTH
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER
MANAGEMENT PLAN-3
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

- □ MINOR URBAN WASTEWATER TREATMENT PLANTS
- [T] MAJOR URBAN WASTEWATER TREATMENT PLANTS
- △ NON URBAN WASTEWATER TREATMET PLANTS





METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

LAND TREATMENT AREAS
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

VENS AND EMERSON, LTD.

Table F-1

IRRIGATION WATER QUALITY
Plan 3

Parameter	Concentration* (mg/1)
BOD	30**
SS	30**
TDS	500
P	7-8**
N	18-28**
K	14
Na	50
Ca	24
Mg	17
SAR	2
pH	7±

*Wastewater Treatment and Reuse by Land Application - Vol. II, USEPA, August, 1973.

**Developed in this Study.

Table F-2

LAND TREATMENT AREA REQUIREMENTS
NON-URBAN PLANTS

Non-Urban Wastewater Treatment Plants	Irrigated Land Requirements (acres) 1995	Irrigated Land Requirements (acres) 2020	Storage Surface Area (acres) 1995	Storage Surface Area (acres) 2020	Storage Land Area (acres) 1995	Storage Land Area (acres) 2020
Arlington	79.8	90.7	6.3	7.2	9.5	10.8
Herman	18.2	17.6	1.5	1.4	2.3	2.1
Kennard	20.0	19.3	1.6	1.5	2.4	2.3
Weeping Water	81.6	90.7	6.5	7.2	9.8	10.8
Union	14.3	13.7	1.1	1.1	1.7	1.7
Nehawka	22.8	28.0	1.8	2.2	2.7	3.3
Murray	19.3	20.6	1.5	1.6	2.3	2.4
Murdock	18.8	20.6	1.5	1.6	2.3	2.4
Manley	10.8	12.0	8.6	1.0	12.9	1.5
Louisville	53.1	50.8	4.2	4.0	6.3	6.0
Greenwood	51.4	69.0	4.1	5.5	6.2	8.3
Elmwood	45.1	56.4	3.6	4.5	5.4	6.8
Eagle	46.2	61.6	3.7	4.9	5.6	7.4
Avoca, Nebr.	16.0	17.6	1.3	1.4	2.0	2.1
Alvo	8.0	8.0	0.6	0.6	0.9	0.9
Logan	117.3	128.8	8.4	9.2	12.6	13.8
Woodbine	101.0	128.8	8.0	9.2	12.0	13.8
Mondamin	23.4	20.0	1.9	1.6	2.9	2.4
Dunlap	87.8	94.6	7.0	7.5	10.5	11.5
Pisgah	18.2	19.3	1.5	1.5	2.3	2.3
Avoca, Iowa	86.1	87.2	6.8	6.9	10.2	10.4
Carson	53.6	57.0	4.3	4.5	6.5	6.8
Hancock	16.0	17.6	1.3	1.4	2.0	2.1
Macedonia	25.6	29.7	2.0	2.4	3.0	3.6
Minden	31.4	33.6	2.5	2.7	3.8	4.1
Neola	71.3	87.2	5.7	6.9	8.6	10.4
Oakland	107.8	129.5	8.6	10.3	12.9	15.5
Treynor	79.8	121.0	6.3	9.6	9.5	14.4
Underwood	48.4	64.4	3.9	5.1	5.9	7.7
Walnut	48.4	48.4	3.9	3.9	5.9	5.9
Emerson	34.2	43.1	2.7	3.1	4.1	6.2
Malvern	61.0	56.4	4.9	4.5	7.4	6.8
Tabor	63.3	73.5	5.0	5.8	7.5	8.7
Waterloo	36.1	57.1	2.6	4.1	3.9	6.2
Total	1,616.1	1,873.8	135.2	145.9	203.8	221.4

Table F-3

LAND TREATMENT AREA REQUIREMENTS

Treatment Plants	Irrigated Land Requirements (Acres) 1995 A	1995 B	1995 C	1995 D	2020 A	2020 B	2020 C	2020 D
Minor Urban								
E Bellevue	-	416	-	-	-	440	-	-
Deer Creek	-	297	-	-	-	440	-	-
Bennington	188	1,585	188	188	267	2,286	267	267
Elkhorn	223	1,585	223	223	981	2,286	354	354
Valley	274	531	274	274	365	655	365	365
Boystown	97	113	132	97	182	137	223	182
Springfield	234	2,115	234	234	484	2,726	484	484
Gretna	622	2,640	622	622	987	3,809	987	1,785
Blair	987	2,538	987	987	1,123	3,273	1,123	1,123
Fort Calhoun	143	633	143	143	183	872	183	183
Plattsmouth	809	2,115	809	809	878	2,215	878	878
Missouri Valley	416	1,056	416	416	473	1,089	473	473
Glenwood	428	1,056	428	428	393	1,089	393	393
Subtotal	4,421	16,680	4,456	4,421	6,316	21,317	5,730	6,487
Non-Urban	1,616	1,616	1,616	1,616	1,874	1,874	1,874	1,874
Total	6,037	18,296	6,072	6,037	8,190	23,191	7,604	8,361

Treatment Plants	2020 Storage: Surface Area (Acres) A	B	C	D	2020 Storage: Land Area (Acres) A	B	C	D	2020 Total (Acres) A	B	C	D
Minor Urban												
E Bellevue	-	21	-	-	-	32	-	-	-	472	-	-
Deer Creek	-	21	-	-	-	32	-	-	-	472	-	-
Bennington	13	107	13	13	20	160	20	20	287	2,446	287	287
Elkhorn	46	107	16	16	69	160	24	24	1,050	2,446	378	378
Valley	16	32	16	16	24	48	24	24	389	703	389	389
Boystown	8	7	11	8	12	11	17	12	194	148	240	194
Springfield	24	128	24	24	36	192	36	36	520	2,918	520	520
Gretna	45	179	45	83	68	269	68	125	1,055	4,078	1,055	1,910
Blair	53	152	53	53	80	228	80	80	1,203	3,501	1,203	1,203
Fort Calhoun	9	40	9	9	14	60	14	14	197	932	197	197
Plattsmouth	40	101	40	40	60	152	60	60	938	2,367	938	938
Missouri Valley	21	53	21	21	32	80	32	32	505	1,169	505	505
Glenwood	19	53	19	19	29	80	29	29	422	1,169	422	422
Subtotal	294	991	267	302	444	1,504	404	456	6,760	22,821	6,134	6,943
Non-Urban	146	146	146	146	221	221	221	221	2,095	2,095	2,095	2,095
Total	440	1,137	413	448	665	1,725	625	677	8,855	24,916	8,229	9,038

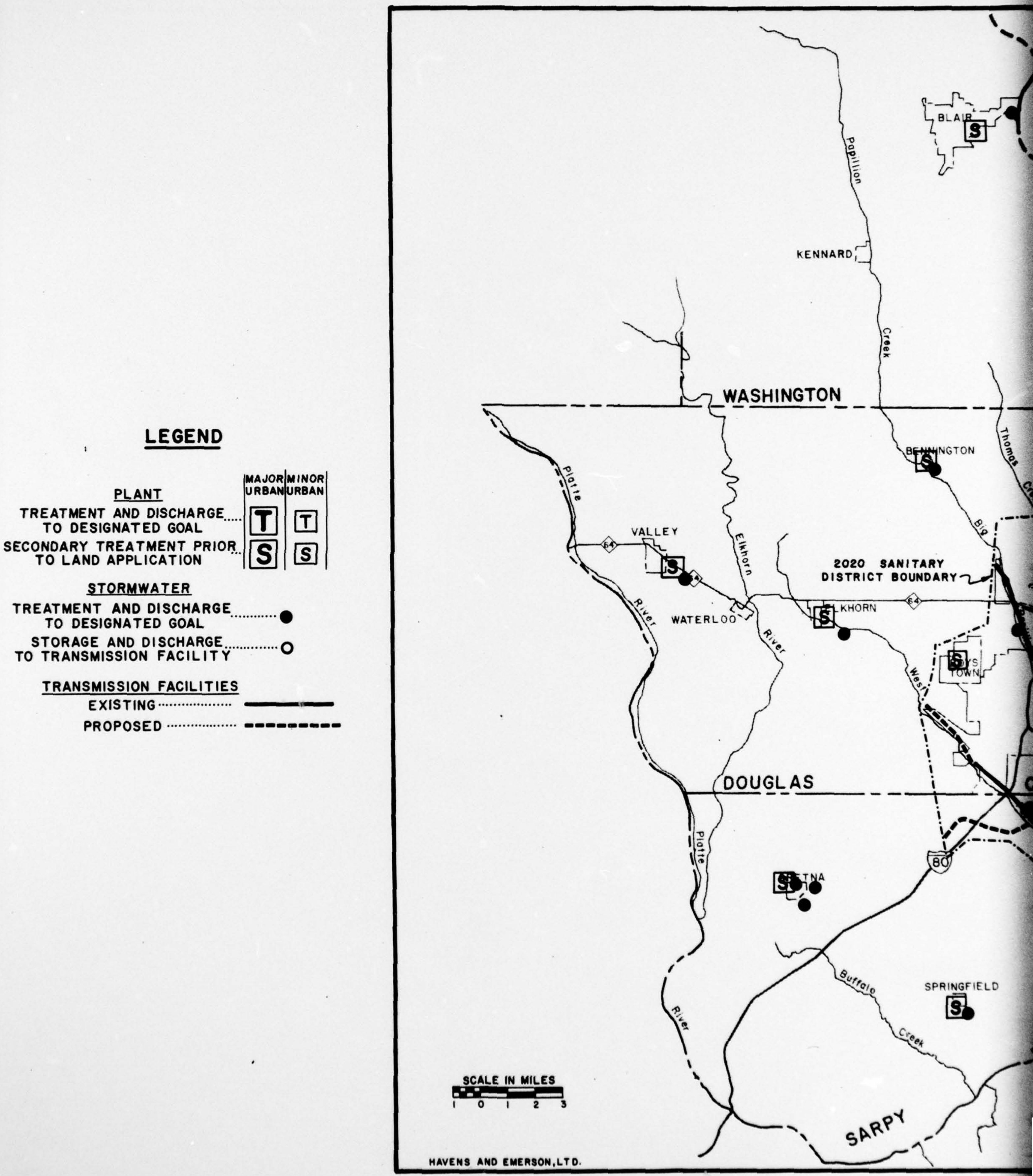
PLAN 3 OPTION

14. This plan, illustrated in figures F-5 and F-6, combines the land treatment components of initial Plans VII and VIII to form an all-land treatment plan. Since secondary treatment was shown to not contravene standards in the Missouri River under certain conditions, options for a major land treatment system are presented to show the possibilities of large scale irrigation. The option presumes irrigation with secondary effluent during summer and discharge to the Missouri River in the winter. The winter storage requirements are therefore eliminated and only storage to allow for non-uniform application is required.

15. Six land areas were considered as indicated on figure F-6 for the effluents from the major treatment plants of Omaha-Council Bluffs. The two best areas for land irrigation, within a 100-mile radius of Omaha were found to be in the Upper Blue River basin and the Todd Valley.

16. The Upper Blue River basin has a declining ground water table and needs additional water for irrigation. The area is already extensively irrigated. The potential exists for placing several hundred thousand acres of additional land under irrigation if more water were available.

17. An area closer to Omaha is the Todd Valley. Due to more favorable precipitation, this area does not have as critical a need for irrigation water as the Blue basin. Approximately 500,000 acres of highly suitable lands are available for irrigation in the Todd Valley and adjacent areas.


LEGEND
PLANT
MAJOR URBAN
MINOR URBAN
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
SECONDARY TREATMENT PRIOR TO LAND APPLICATION
STORMWATER
TREATMENT AND DISCHARGE TO DESIGNATED GOAL
STORAGE AND DISCHARGE TO TRANSMISSION FACILITY
TRANSMISSION FACILITIES
EXISTING
PROPOSED
BLAIR
Papillion
KENNARD
Creek
WASHINGTON
Thomas
BENNINGTON
Big
Platte
VALLEY
Elkhorn
2020 SANITARY DISTRICT BOUNDARY
ELKHORN
WATERLOO
River
West
TOWN
DOUGLAS
80
Platte
River
Buffalo
Creek
SPRINGFIELD
SCALE IN MILES
1 0 1 2 3
SARPY
HAVENS AND EMERSON, LTD.

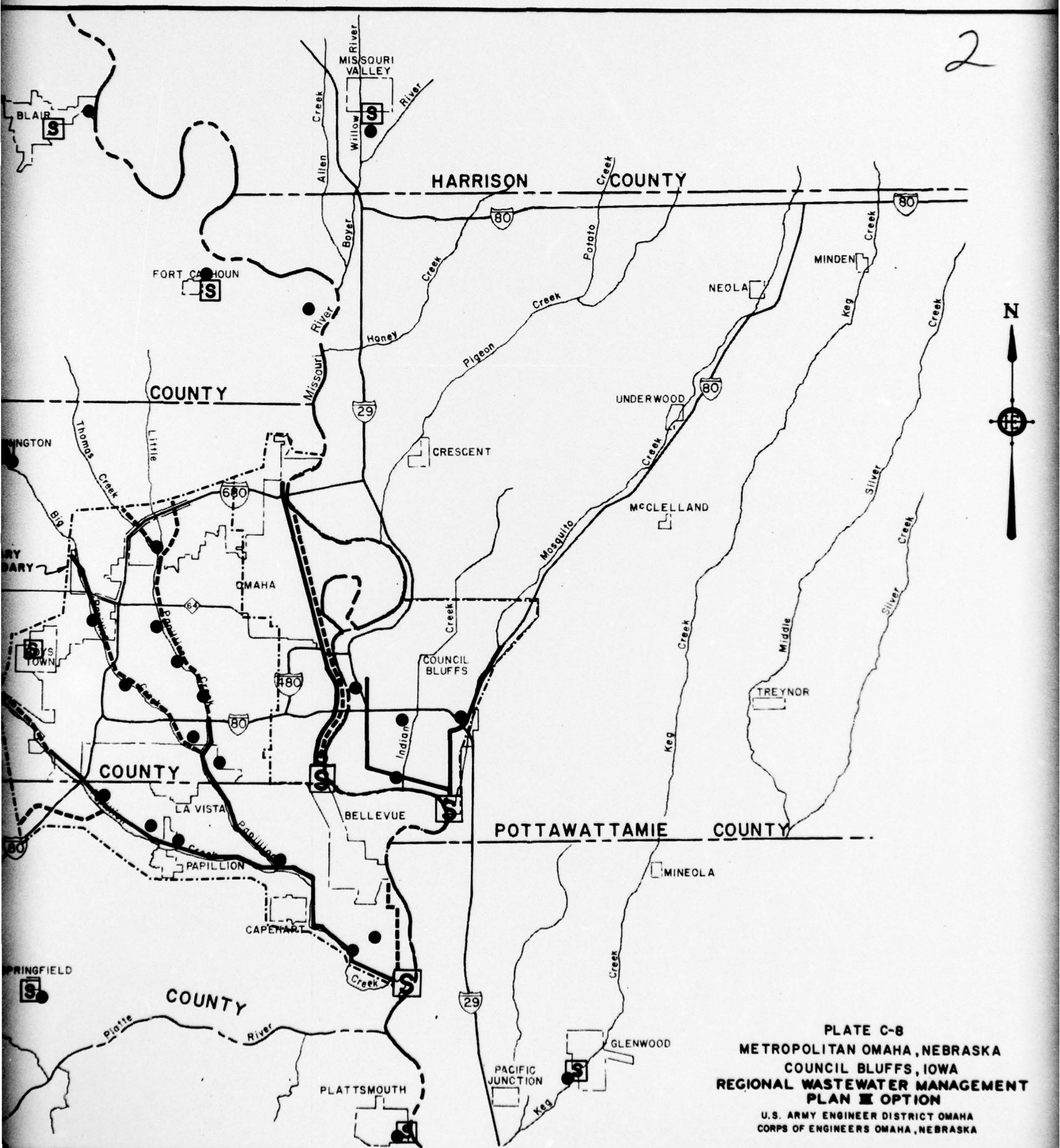
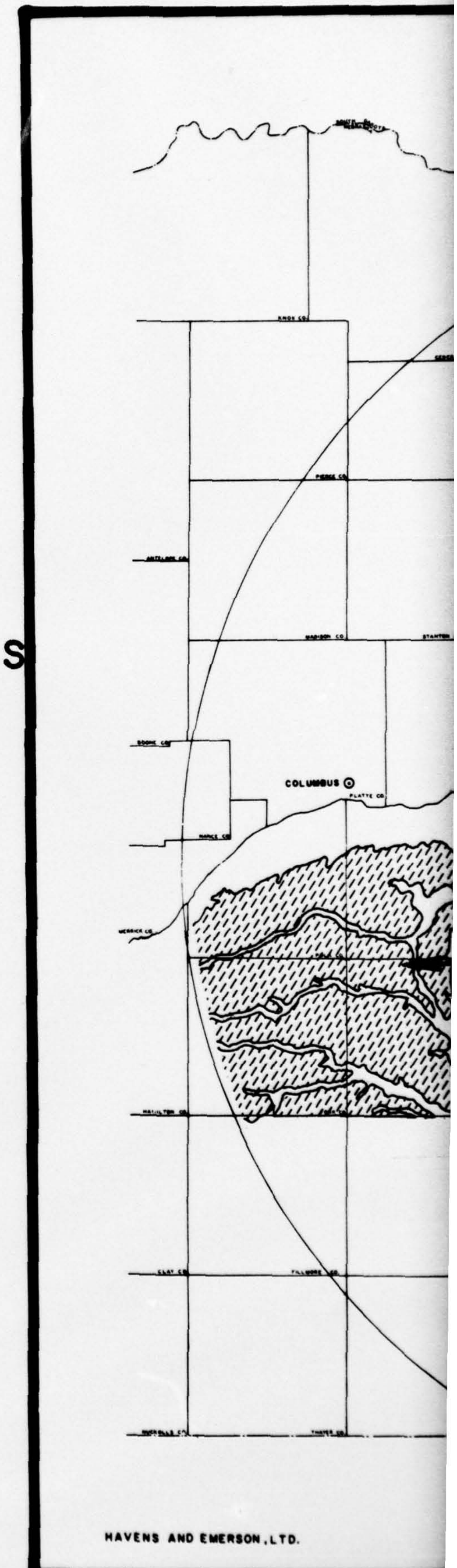


PLATE C-8
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
REGIONAL WASTEWATER MANAGEMENT
PLAN III OPTION
U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

LEGEND

LAND TREATMENT PRIORITY OF SITES

- №1 23 AND 22 - Nebraska
- №2 29 AND 30 - Nebraska
- №3 21, 22 AND 26 - Nebraska
- №4 26 AND 29 - Iowa
- №5 6 AND 14 - Iowa
- №6 12, 18, 33 AND 34 - Iowa



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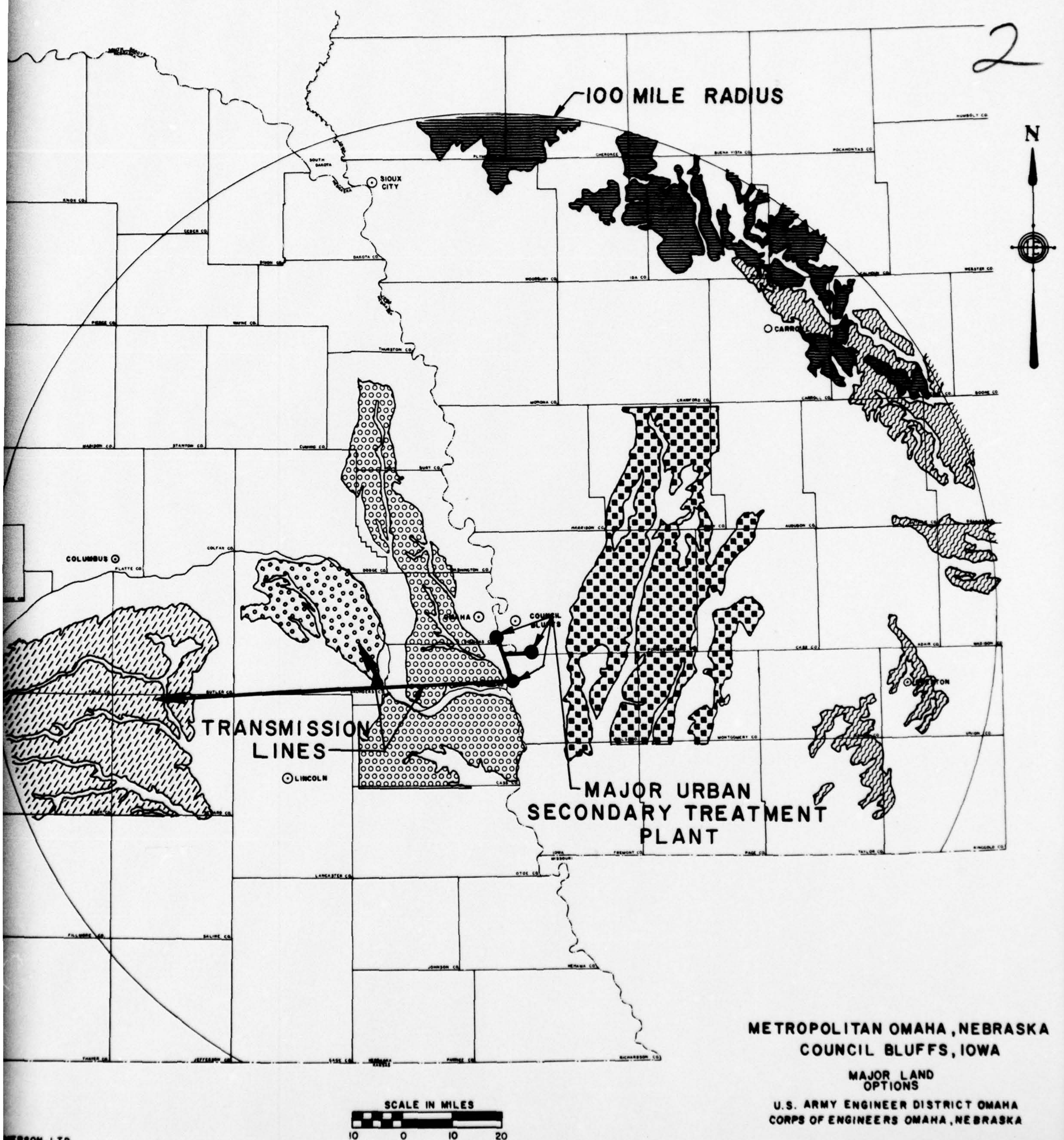


METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MAJOR LAND OPTIONS

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

ERSON, LTD.

18. Several variations exist when considering three major plants and two major land masses applicable to land treatment. Three main options are considered. Option 1 envisions all of the 1995 flow transported to Priority 1 sites and future flows taken to Priority 2 sites. Option 2 takes all flow to Priority 1 sites and Option 3 takes all flow to Priority 2 sites.

19. Another variable considered the number of treatment plants involved in land treatment. The combinations presented are: Papillion, Missouri River, and Council Bluffs; Papillion and Missouri River; Papillion; and an increment is developed if the Papillion sewer system is extended rather than limited. Irrigation water quantity under each combination is given in table F-4.

20. Another variable considered involved the wastewater application rate. The wastewater management consultant recommended an application rate of 33 inches per acre per year, balancing irrigation and disposal objectives.

21. Table F-5 indicates the amount of land required for storage and the amount under irrigation using an application rate of 33 inches per year. A 12- to 15-inch application rate is more publicly acceptable and produces more benefits than the higher rate, as explained in the next section. The amount of land required for the lower application rate would be proportionally higher.

22. Table F-6 indicates the water quality, after secondary treatment, from the three major urban treatment plants. Particular note should be made of the Sodium Absorption Ratios (SAR) for the

Table F-4

IRRIGATION WATER QUANTITY
MAJOR LAND TREATMENT OPTIONS
Quantity (ac-ft/yr*)

Supply	1985				2020			
	A	B	C	D	A	B	C	D
Papillion - Limited (PL)	34,638	28,340	33,146	36,212	81,929	59,879	74,322	79,816
Papillion - Extended (PE)	35,881	33,063	34,638	37,455	86,338	73,146	77,570	84,382
PL+Missouri River STP (M)	69,193	61,321	69,524	71,347	131,914	109,747	130,240	129,778
PL+M+Council Bluff STP	79,468	70,933	79,800	81,291	156,724	131,839	155,066	154,743

*270 Days/Year.

Table F-5

LAND TREATMENT AREA REQUIREMENTS MAJOR URBAN LAND OPTIONS

Priority 1 (by 1995)

Treatment Plants*	Irr. Land Req'd. (ac)				Storage Surface (ac)				Storage Land (ac)				Total Land			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
M	19,818	18,228	21,624	20,388	580	534	633	597	870	801	950	896	20,688	19,029	22,574	21,284
CB	6,923	6,198	6,952	6,569	203	181	204	192	305	272	306	288	7,228	6,470	7,258	6,857
PE	26,146	23,236	24,818	27,703	766	680	727	811	1,149	1,020	1,091	1,717	27,295	24,256	25,909	29,420
PL	24,826	18,465	23,372	26,467	727	541	684	775	1,091	812	1,026	1,163	25,917	19,277	24,398	27,630
PL+M+CB	51,567	42,891	51,948	53,422	1,510	1,256	1,521	1,564	2,266	1,885	2,282	2,347	53,833	44,776	54,230	55,769
PL+M	44,644	36,693	44,996	46,855	1,307	1,075	1,307	1,372	1,961	1,613	1,976	2,059	46,605	38,306	46,972	48,914
PE-PL	1,320	4,771	1,446	1,236	39	139	43	36	58	208	65	554	1,378	4,979	1,511	1,790

Priority 2 (1995-2020)

Treatment Plants*	Irr. Land Req'd. (ac)				Storage Surface (ac)				Storage Land (ac)				Total Land			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
M	5,628	7,160	6,844	5,046	165	210	200	148	248	315	300	222	5,876	7,475	7,144	5,268
CB	5,708	5,048	5,687	6,142	167	148	167	180	251	222	251	270	5,959	5,270	5,938	6,412
PE	17,808	14,001	14,672	15,255	521	410	430	447	782	615	645	670	18,590	14,616	15,317	15,925
PL	16,883	12,019	14,464	14,167	494	352	424	415	741	528	636	623	17,624	12,547	15,100	14,790
PL+M+CB	28,219	24,227	26,995	25,355	359	710	791	743	1,240	1,065	936	1,115	29,459	25,292	27,931	26,470
PL+M	22,511	19,179	21,308	19,213	192	562	624	563	989	843	1,187	845	23,500	20,022	22,495	20,058
PE-PL	975	1,982	208	1,088	27	58	6	32	41	87	9	47	1,016	2,068	217	1,135

*M - Missouri River STP
CB - Council Bluffs STP
PE - Papillion STP Extended Sewer
PL - Papillion STP Limited Sewer

Table F-6

IRRIGATION WATER QUALITY
MAJOR LAND TREATMENT OPTION
(mg/l)

	1995 Avg. Flow (mgd)	Na	Ca	Mg	TDS	SAR	P mgl	P #/ac*	N mgl	N #/ac
Papillion STP (PL)	55	175	46	21	704	5	6	43	26	188
Missouri River STP (M)	47	340	61	18	1,111	10	5	36	33	239
Council Bluffs (CB)	16	484	47	26	1,686	14	4	36	34	246
PL+M+CB	118	283	52	20	999	8	5.5	40	30	217
PL+M	102	251	53	20	892	7	5.5	40	29	210

* Using 33" of Water Per Year

Missouri River and Council Bluffs treatment plants. The Nebraska Water Quality Standards for irrigation use state that "the SAR value and conductivity shall not be greater than a C3-S2 Class irrigation water as shown in figure 25 of the Agricultural Handbook 60, U. S. Department of Agriculture". The SAR and approximate conductivity values for each of the major urban plants and their combinations are shown in figure F-7. Council Bluffs effluent alone is greater than the irrigation water standard; the Papillion plant effluent alone is less than the standard; and the other wastewater plant effluent combinations of table F-6 meet the standard for irrigation water.

23. The transmission line to the major land irrigation areas would be a 90-inch force main with a length of 35 miles to the Todd Valley area or a length of 65 miles to the Blue River basin.

24. Five pumping stations are required to the Todd Valley with an additional 5 stations required to the Blue River basin.

Combined Sewer Overflows

MISSOURI RIVER

25. Five conveyance and storage alternatives remain for final analysis for the solution to the abatement of the combined sewer

overflow problem in the Omaha-Missouri River sewerage system. The following paragraphs summarize the five remaining alternatives.

NEW ALTERNATIVE 1 - BURIED STORAGE AT OVERFLOW POINTS (Figure F-8)

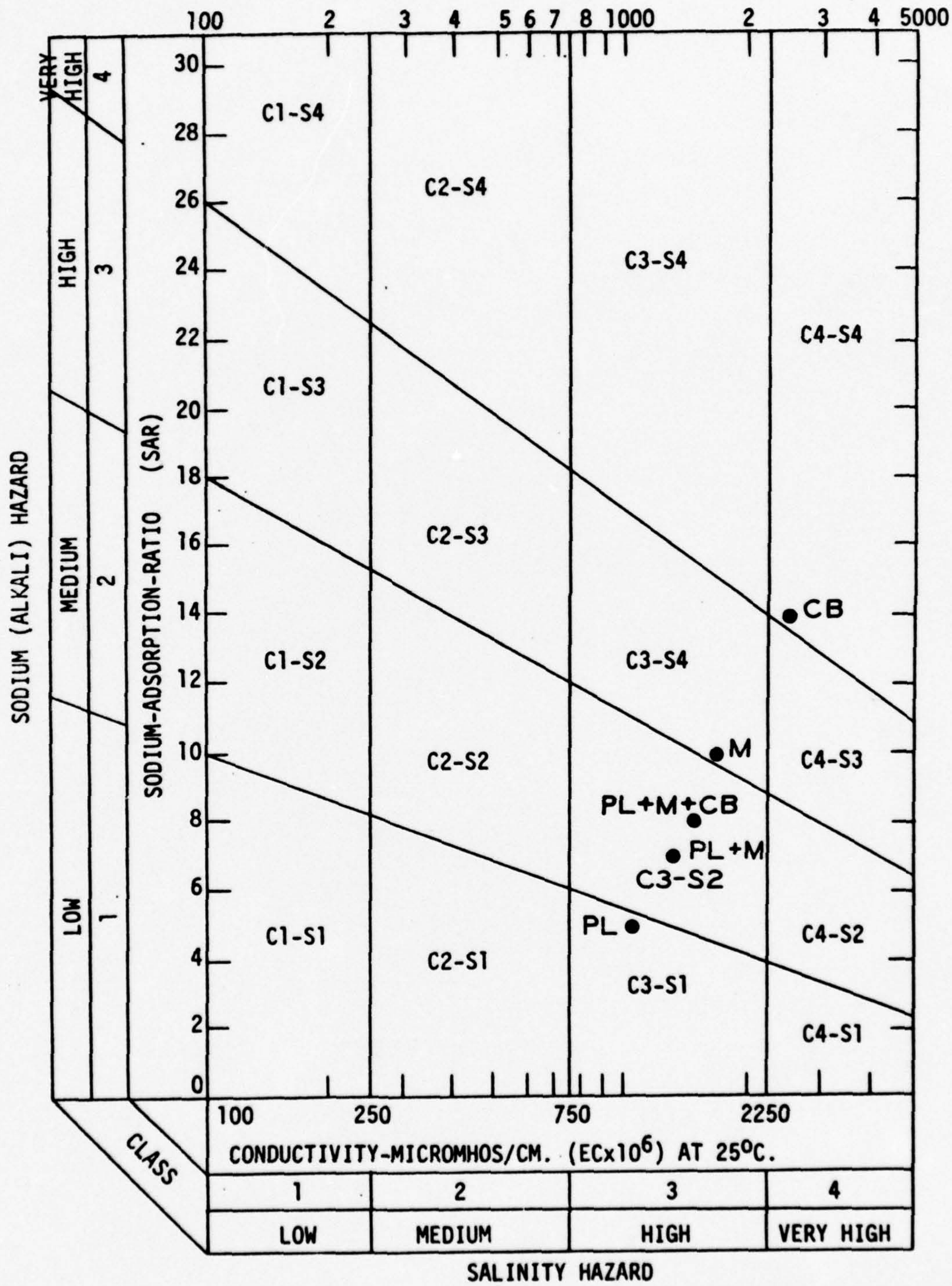
26. This alternative consists of buried concrete storage reservoirs located at selected points along the Missouri River. The reservoirs would capture the most concentrated portion of the overflowed wastewater before it entered the Missouri River. The captured overflows would receive a certain degree of treatment and disinfection and would then be discharged to the river. General locations of the reservoirs are shown on figure F-8. All reservoirs would be located below ground.

27. The total storage volume amounts to 1,250 acre-feet and is the sum of the storage required for holding the treatment rate for the 2-hour detention period, plus the volume of runoff which enters the basin at rates greater than the treatment rate.

ALTERNATIVE 2 - DIKED STORAGE ALONG LEVEE (Figure F-9)

28. The existing sewers would be utilized as the storm flow conveyance system. The existing flood-control levee would be used as one side of diked reservoirs constructed along the riverfront to capture and retain overflows. The overflows that are presently discharged to the Missouri River would be diverted by control structures at the outfalls.

29. Five diked storage reservoirs, located near the Minne Lusa, Grace Street, Leavenworth, South Omaha, and Monroe Street outfalls would be used. In addition, the plan would require diversion structures at the outfalls, conveyance systems from selected outfalls to



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MAJOR URBAN IRRIGATION
WATER QUALITY

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

COUNCIL BLUFFS
IOWA
EPPLEY AIRFIELD
NORTH OMAHA AIRPORT
SKYRANCH AIRPORT

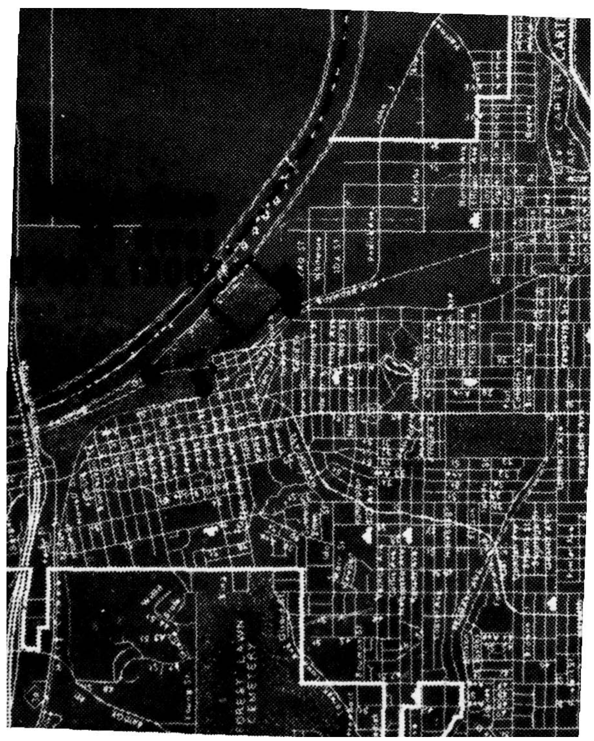
2

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

NEW ALTERNATIVE I
BURIED STORAGE AT OVERFLOW POINTS

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

VOLUME III ANNEX B FIGURE F-8



the reservoirs, floating aerators in the reservoirs, pumping stations to pump out the stored overflows, and treatment facilities.

ALTERNATIVE 4A - DEEP TUNNEL NORTH TO GROUND LEVEL STORAGE (Figure F-10)

30. This alternative plan uses a deep tunnel system to convey combined sewer overflows to a ground-level reservoir located north of Council Bluffs in Iowa. Combined sewer overflows would be diverted to vertical drop shafts and conveyed to a tunnel located approximately 500 feet below the ground surface. This tunnel would be bored through a sound rock formation, paralleling the existing interceptor. The flow would be from the Monroe Street outfall north to the Minne Lusa outfall, then underneath the Missouri River to the reservoir in Iowa. The difference in elevation between the land along the western edge of the Missouri River and the low-lying area north of Council Bluffs would be sufficient to allow the water to flow by gravity to a ground level storage reservoir. Captured overflow would then be pumped back across the Missouri River into the interceptor and conveyed to the Missouri River plant for treatment.

ALTERNATIVE 4B - EXCAVATED STORAGE NORTH - DEEP TUNNEL SOUTH TO GROUND LEVEL STORAGE (Figure F-11)

31. This plan would use two excavated, open reservoirs in the northern zone to store the overflow from the Mormon, Minne Lusa, and Grace Street service areas. In the southern zone, the elevation differential between the bluffs and the river would provide energy to convey overflows from the Burt-Izard Street service area south to a ground level reservoir in Iowa. Conveyance for the southern zone would be by deep tunnel, constructed several hundred feet below grade in sound rock formations. Captured overflow

would then be pumped at a controlled rate to the interceptor and conveyed to the Missouri River plant for treatment.

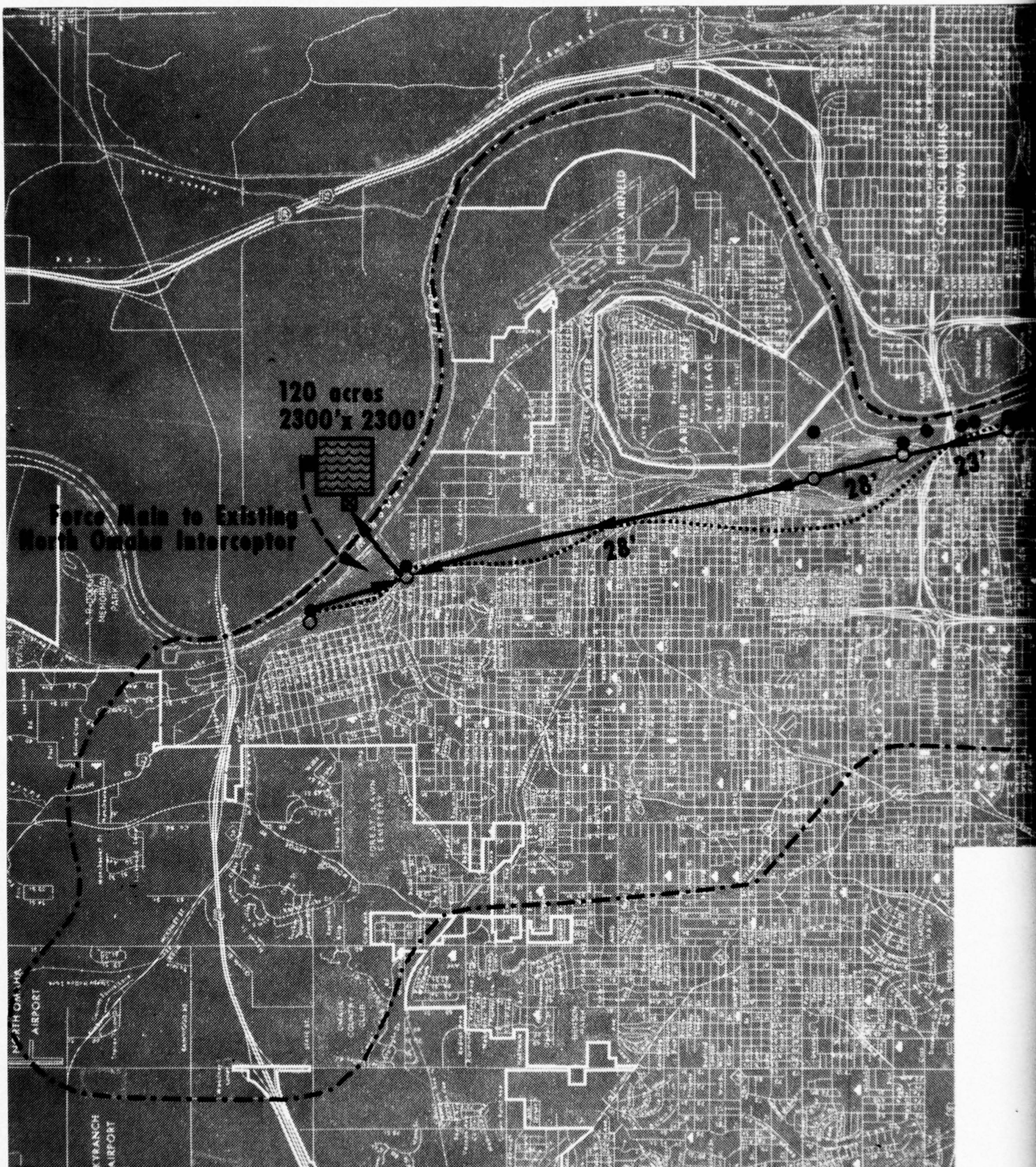
ALTERNATIVE 5A - DEEP TUNNEL WITH MINED STORAGE (Figure F-12)

32. This alternative consists of a deep tunnel system for conveying combined sewer overflows to a storage reservoir mined in sound rock beneath the Missouri River Treatment Plant. The combined sewer overflow would be dropped through vertical shafts to an unlined tunnel that would generally parallel the Missouri River. The tunnel would be designed to flow full and to use the available head to convey the overflows to a central mined storage reservoir about 500 feet below the surface. The mined reservoir would consist of large unlined chambers in the Mississippian geologic formation. The reservoir would be divided into two separate sections with the first used for solids separation and settling and the second as the main area for aerated storage.

33. The solids settling section would be sized to contain overflows from smaller storms, while retaining the majority of the solids generated by most storms. The excess from larger storms would overflow into the main storage reservoir. This partially biologically treated overflow would then be pumped to the treatment facility at the ground surface at a constant rate.

SUMMARY

34. The conveyance and storage approach developed in the Harza study provides a small continuous discharge from the Missouri River Treatment Plant. This flow produces a negligible effect on the DO of the river, using an effluent quality equivalent to the stormwater Level 1, according to the stream modeling results. Therefore,


120 acres
2300'x 2300'
Force Main to Existing
North Omaha Interceptor
28'
28'
23'
COUNCIL BLUFFS
IOWA
EPPLEY AIRFIELD
CARTER LAKE
NORTH OMAHA AIRPORT
SKYRANCH AIRPORT

2

LEGEND

EXISTING

Combined Sewer Service Area

Combined Sewer Outfall

Treatment Plant

PROPOSED

Note: 5 Year Design Recurrence Interval

Deep Tunnel Diameter 36'

Force Main

Surface Intersection of Hydraulic Grade

Treatment Plant

Pumping Facility

Lift Station

Vertical Drop Shaft

Ground Level Storage

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

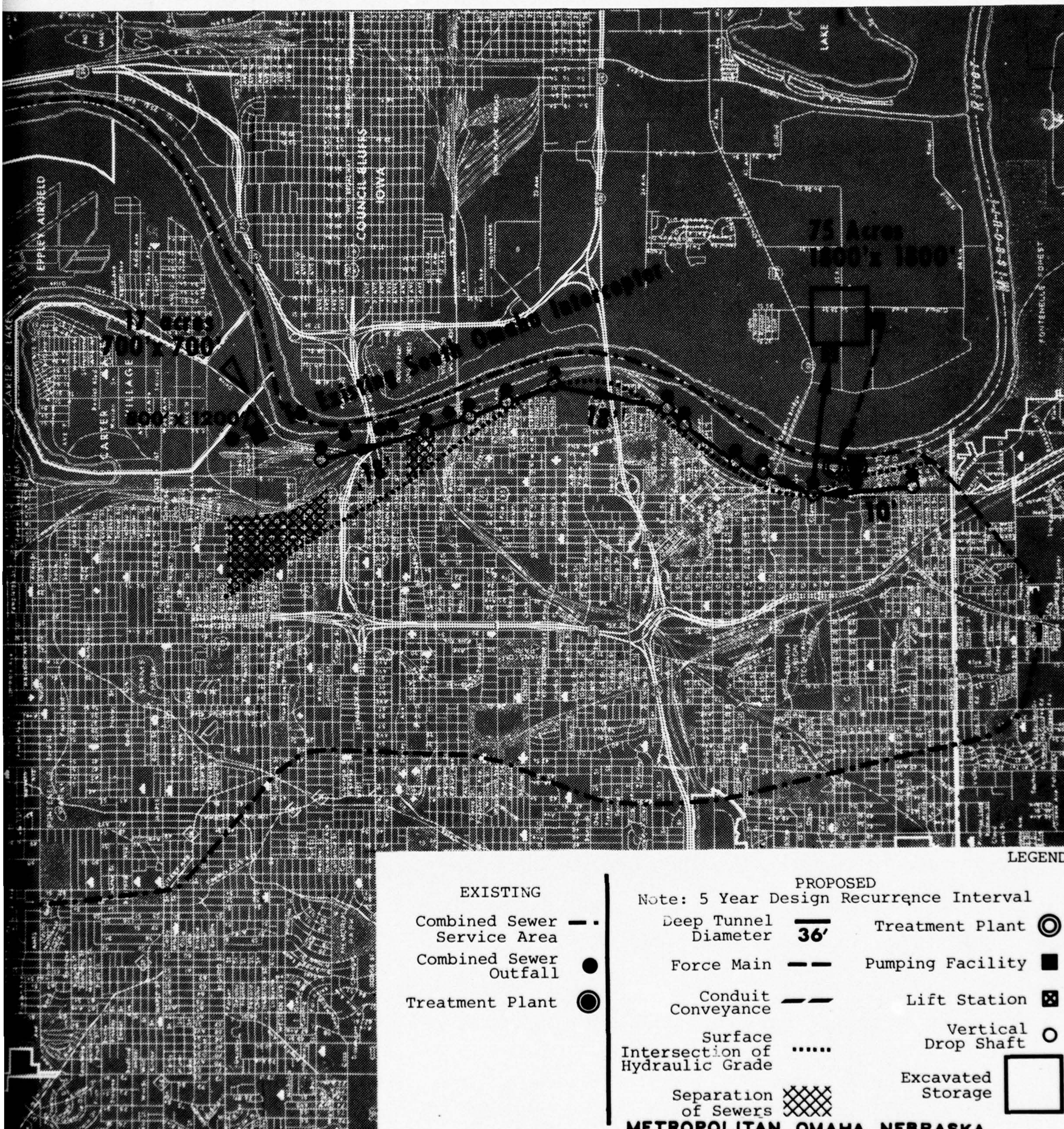
COMBINED SEWER OVERFLOW
ALTERNATIVE 4A

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975


17 acres
700' x 700'
50 acres
800' x 1200'

2



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

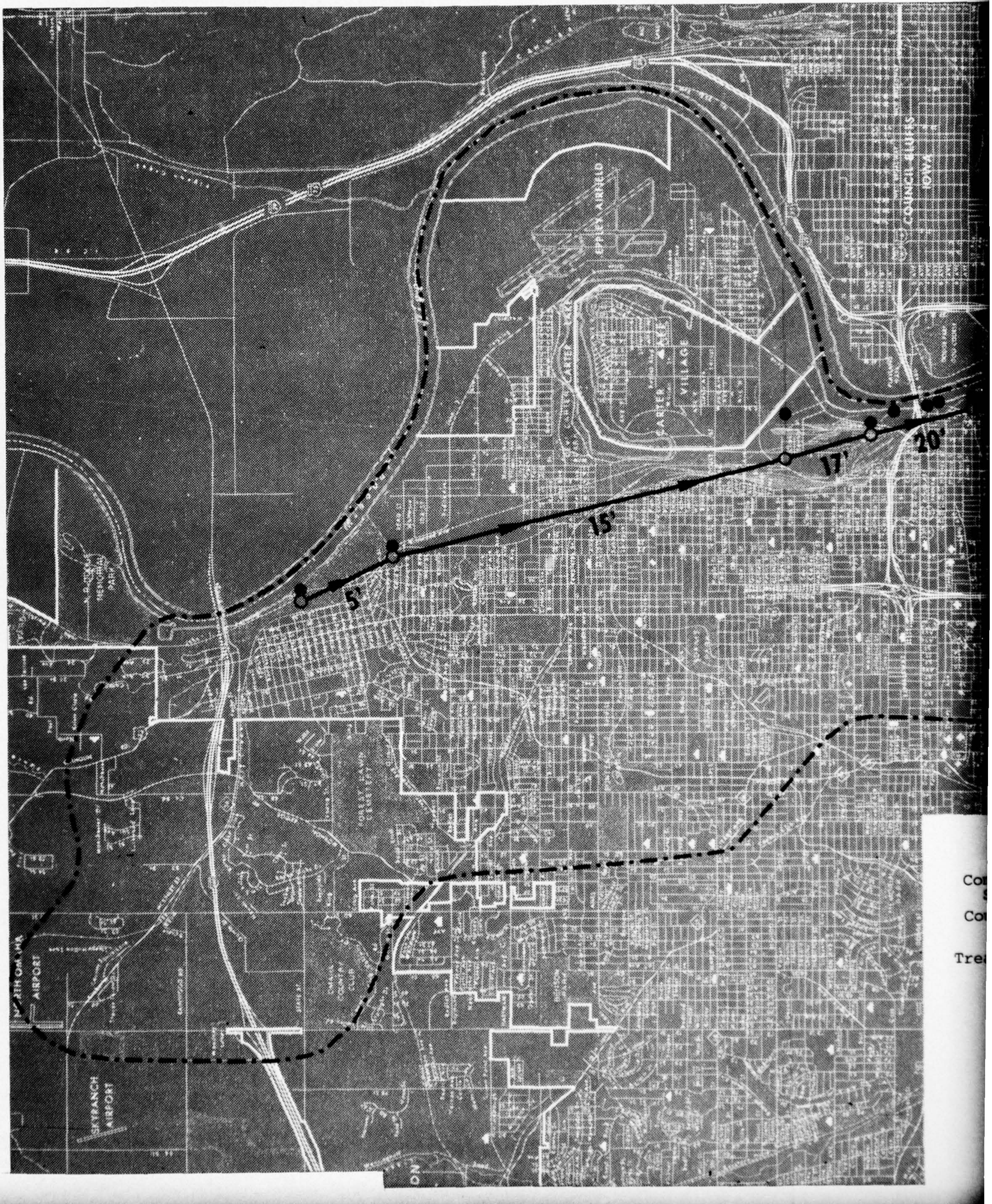
COMBINED SEWER OVERFLOW
ALTERNATIVE 4B

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE F-11

4


COUNCIL BLUFFS
EPPLEY AIRFIELD
CARTER LAKE
VILLAGE
NORTH OMAHA AIRPORT
SKYRANCH AIRPORT
5'
15'
17'
20'

Co
S
Co
Tre

2

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

COMBINED SEWER OVERFLOW
ALTERNATIVE 5A

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE F-12

the main objective in solving the overflow problem is storage to prevent a shock load of pollutants from entering the river. Secondary treatment would not be required.

35. Sewer separation and in-system attentuation devices were further evaluated as components of the above alternatives aimed at reducing facility sizing. Neither proved to be cost-effective in application.

PAPILLION CREEK

36. The two areas within the Papillion Creek sewerage system which are presently combined sewer areas are in the Benson-Westside and Saddle Creek service areas. The combined sewer overflows presently discharge into Little Papillion Creek.

37. Three alternative solutions for the abatement of the combined sewer overflows were analyzed. The first of these is separation of the combined sewers and sanitary sewers. The other two alternatives involve collection and storage of the combined sewer overflows near their discharge point to Little Papillion Creek and treating the overflows in one of two ways. The first would involve upsystem treatment near the storage basin. The second would involve conveyance of the wastewater at a slower, controlled rate to the Papillion Creek Sewage Treatment Plant for treatment. These two alternatives are shown in figure F-13. The levels of treatment provided by these two alternatives would be the same as the stormwater treatment that is described in the planning criteria section of this report.

INDIAN CREEK

38. Only one portion of the Council Bluffs sewerage system is composed mainly of combined sewers, that being in the Indian Creek watershed. *In 1967, the city of Council Bluffs had a plan developed for sewer separation.* The cost of this plan is approximately \$3.4 million.

39. In order to determine if separation is cost-effective, two basic solutions other than separation were considered. These are upsystem storage and treatment and upsystem storage and conveyance to the sewage treatment plant for treatment. These alternatives are shown in figure F-14.

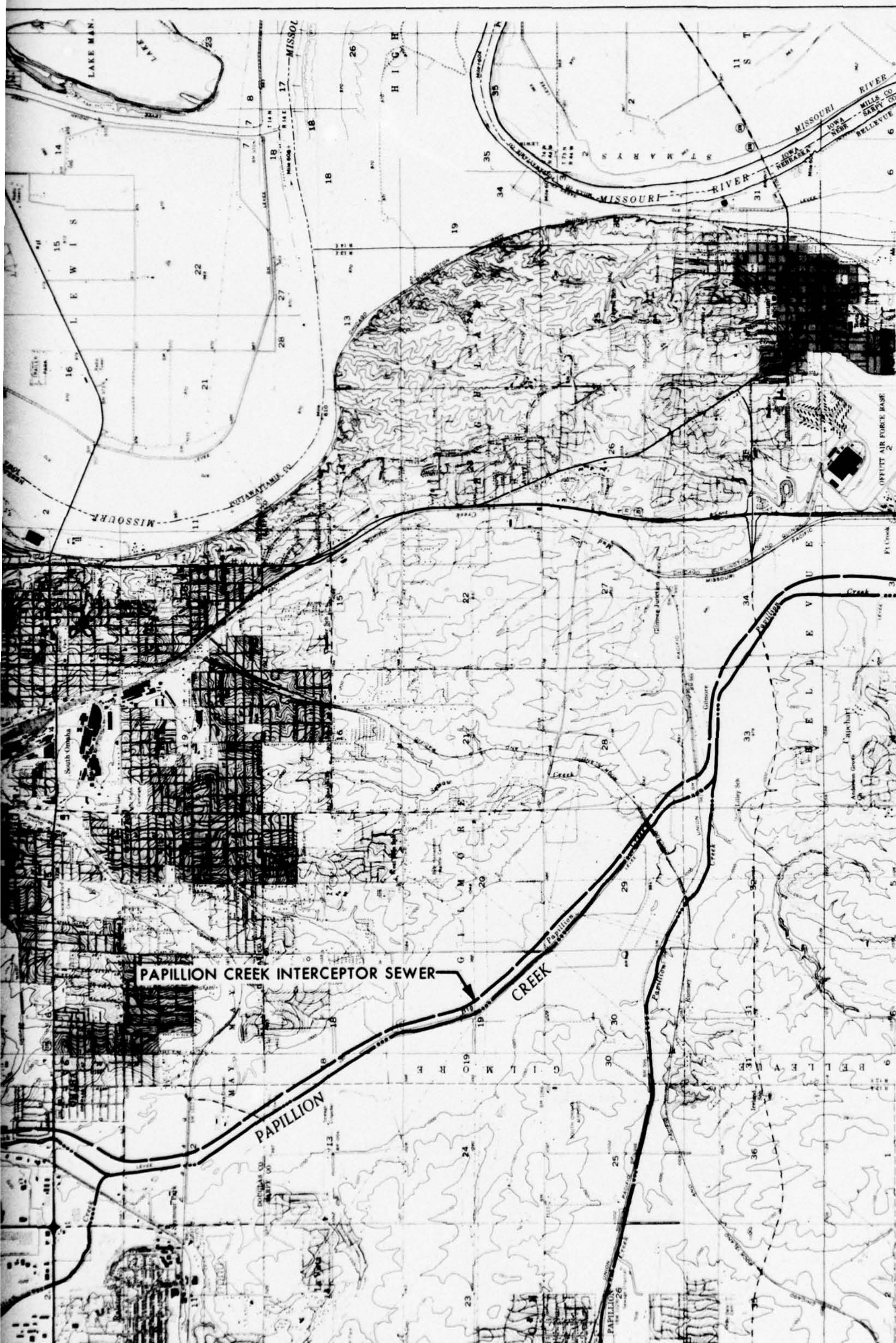
Stormwater

STRUCTURAL ALTERNATIVES

40. Stormwater treatment facilities are located on figure F-15. The facilities consist of storage, screening, settling, and chlorination. Covered concrete storage basins were used for existing urban areas where buffer space was limited. Open earthen basins were used in new growth areas where adequate land area could be made available.

COMBINED SEWER AREA BOUNDARY
PAPILLION CREEK INTERCEPTO
REQUIRED TRUNK SEWERS
REQUIRED STORAGE BASIN
COUNCIL BLUFFS
MISSOURI RIVER
PAPILLION

2

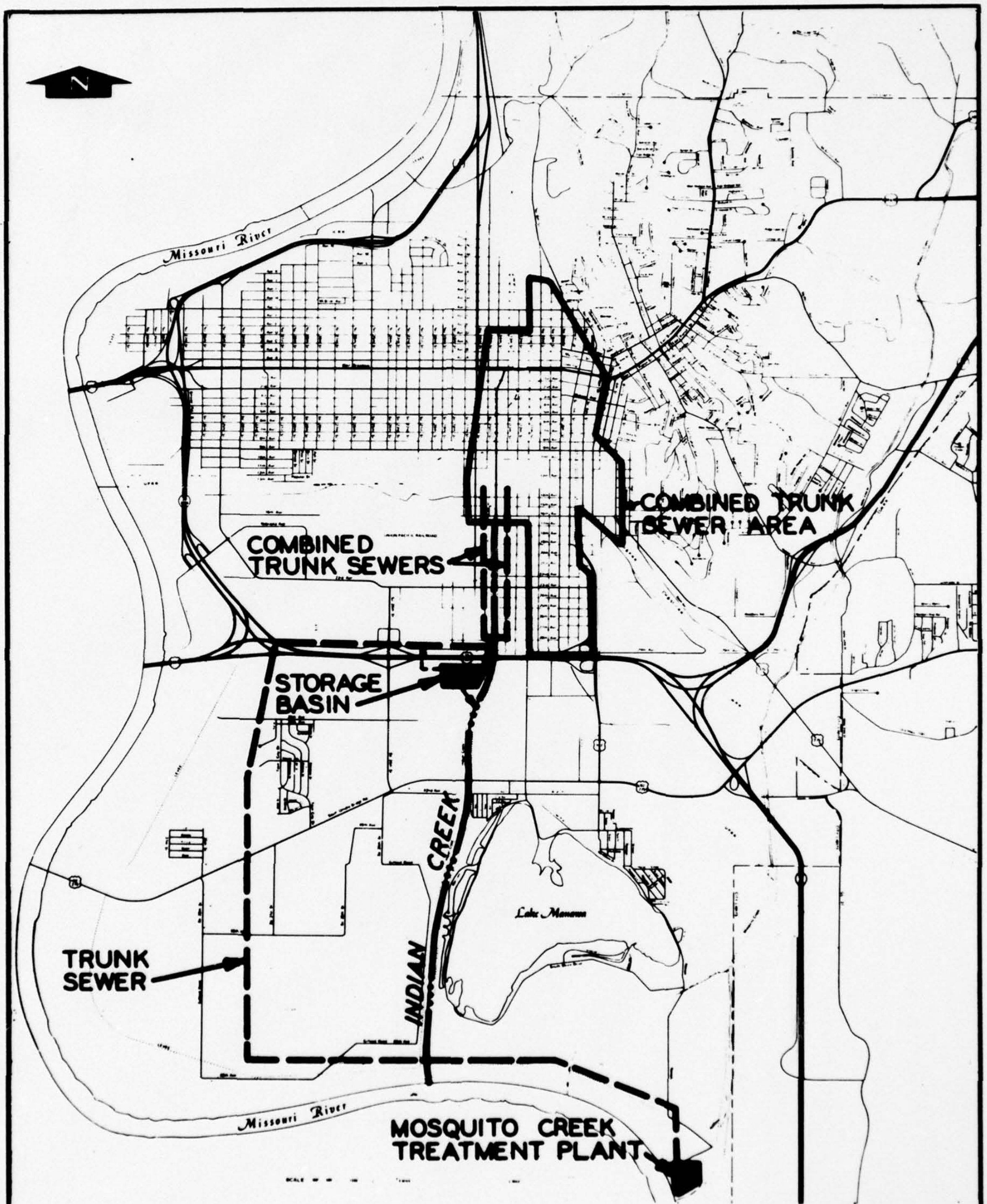


LEGEND:

EXISTING COMBINED TRUNK SEWERS

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
LITTLE PAPILLION CREEK
COMBINED SEWER ALTERNATIVE
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

VOLUME III ANNEX B FIGURE F-13



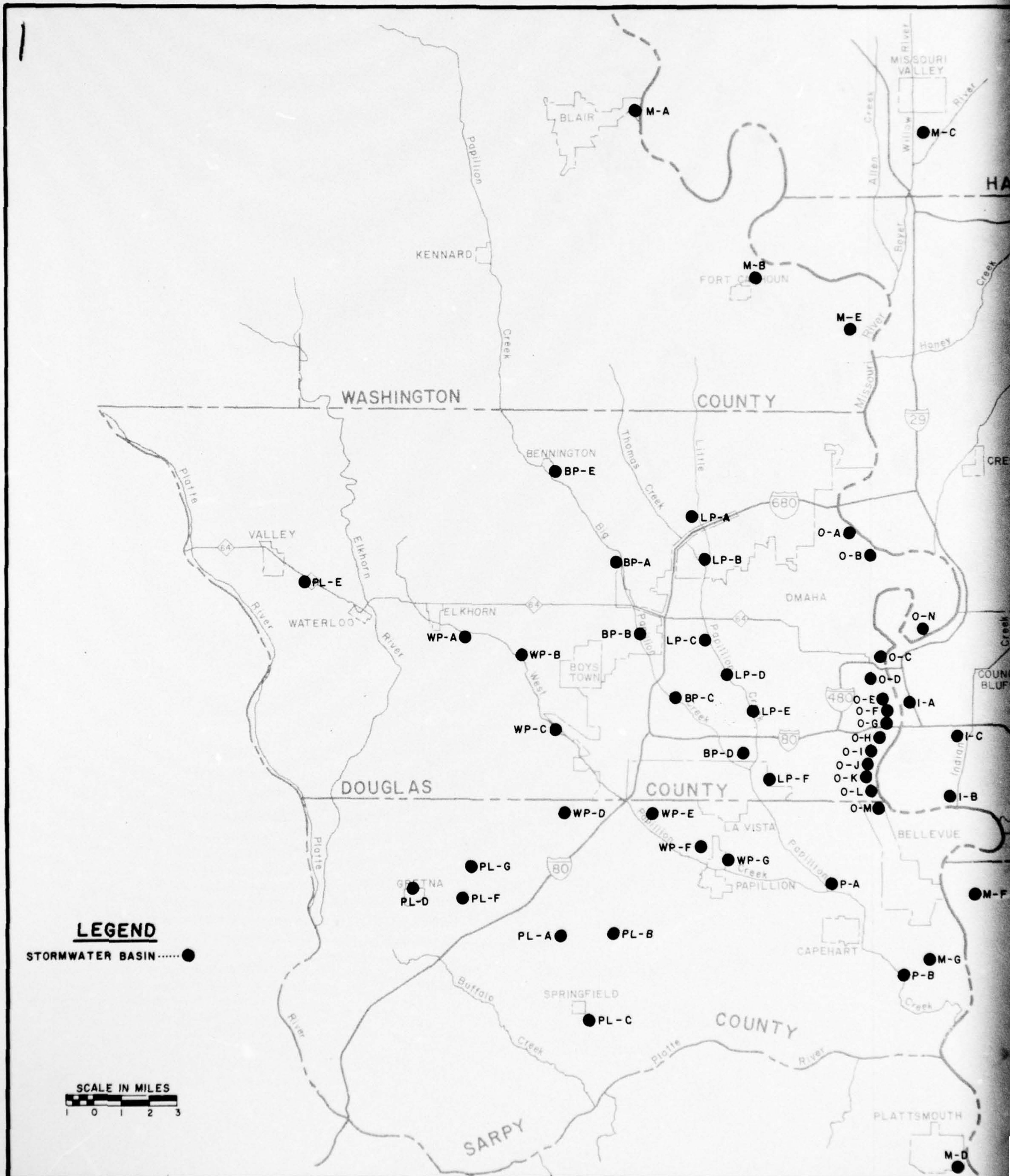
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
INDIAN CREEK
COMBINED SEWER ALTERNATIVE

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

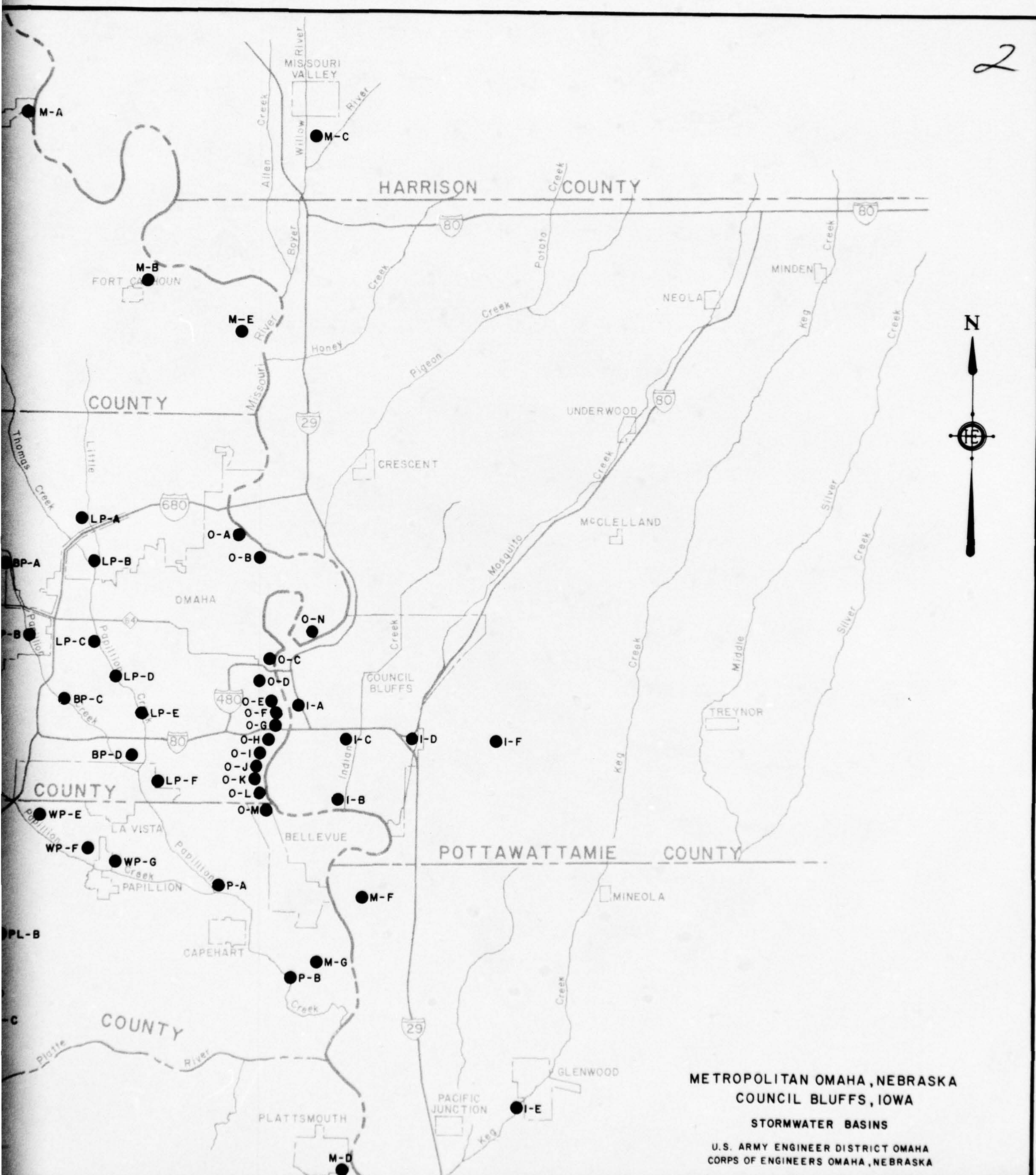
JUNE 1975

VOLUME III ANNEX B FIGURE F-14

1



BLAIR
M-A
MISSOURI VALLEY
M-C
KENNARD
M-B
FORT CALHOUN
M-E
WASHINGTON
COUNTY
BENNINGTON
BP-E
LP-A
O-A
O-B
VALLEY
PL-E
BP-A
LP-B
OMAHA
WATERLOO
ELKHORN
WP-A
WP-B
BP-B
LP-C
O-N
O-C
BOYS TOWN
LP-D
O-D
BP-C
LP-E
O-E
O-F
O-G
I-A
WP-C
O-H
I-C
BP-D
O-I
O-J
O-K
LP-F
O-L
O-M
I-B
DOUGLAS
COUNTY
WP-D
WP-E
LA VISTA
BELLEVUE
WP-F
WP-G
PAPILLION
PL-G
GRETNA
PL-D
PL-F
P-A
M-F
PL-A
PL-B
CAPEHART
M-G
P-B
SPRINGFIELD
PL-C
COUNTY
SARPY
PLATTSMOUTH
M-D
Papillion Creek
Elkhorn River
Platte River
Big Papillion
Thomas Creek
Little Papillion
West Papillion Creek
Buffalo Creek
Missouri River
Boyer River
Willow River
Allen Creek
Honey Creek
Indian Creek
Papillion Creek
LEGEND
STORMWATER BASIN
SCALE IN MILES
1 0 1 2 3



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

STORMWATER BASINS

U.S. ARMY ENGINEER DISTRICT OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

VOLUME III ANNEX B FIGURE F-15

41. For existing urban areas, stormwater collection facilities were included. In non-developed areas, the storm collection system to the basin is not included, but would be incorporated in subdivision development.

42. The 1-year design storm was used in all stormwater sizing and costing. Storage volumes for the stormwater basins are shown in table F-7 along with the corresponding treatment rates.

43. Basins O-A through O-L are those required for the Omaha-Missouri River combined overflows for New Alternative 1. Basins LP-D and LP-E are for combined overflows in Little Papillion Creek and I-C is for combined overflows in Indian Creek.

44. A schematic for the treatment process for the two stormwater treatment levels is shown in figure F-16.

45. Treatment facilities for separate stormwater treatment are assumed to be installed in 1985 for 1995 land use, and in 1995 for 2020 land use.

NON-STRUCTURAL ALTERNATIVES

46. Two non-structural concepts were investigated for urban runoff pollutant reduction.

47. The first concept involved more effective street sweeping. During the summer of 1974 the city of Omaha and the Corps of Engineers participated in a street sweeping analysis program.

Table F-7
Stormwater Treatment Facilities Summary
Upsystem Storage and Treatment (Level 1)

Facility Designation	1 Year Storm, Concept A: Storage Volume (acre ft)	Treatment Rate (cfs)	Collector: Flow (cfs)	Collector: Length (1,000 ft)
BP-A	272	184		
BP-B	297	1,052		
BP-C	193	801	1,013	6.8
BP-D	257	1,099	1,595	12.6
BP-E	6	3		
LP-A	203	99		
LP-B	195	653		
LP-C	168	702	517	10.2
LP-D	155	697	1,124	2.7
LP-E	324	1,592	1,077	5.3
LP-F	283	146	921	9.8
WP-A	95	81		
WP-B	280	166		
WP-C	404	226		
WP-D	798	429		
WP-E	846	468		
WP-F	399	245		
WP-G	70	308		
P-A	874	380		
P-B	770	385		
I-A	310	325	1,076	17.5
I-B	47	18		
I-C	376	391	1,692	15.5
I-D	171	118		
I-E	24	24		
M-A	86	78		
M-B	13	12		
M-C	42	38		
M-D	50	45		
M-G	223	202	184	13.0
PL-A	11	7		
PL-B	13	9		
PL-C	18	12		
PL-D	14	10		
PL-E	42	45		

Table F-7
(Cont'd)
Stormwater Treatment Facilities Summary
Upsystem Storage and Treatment (Level 1)

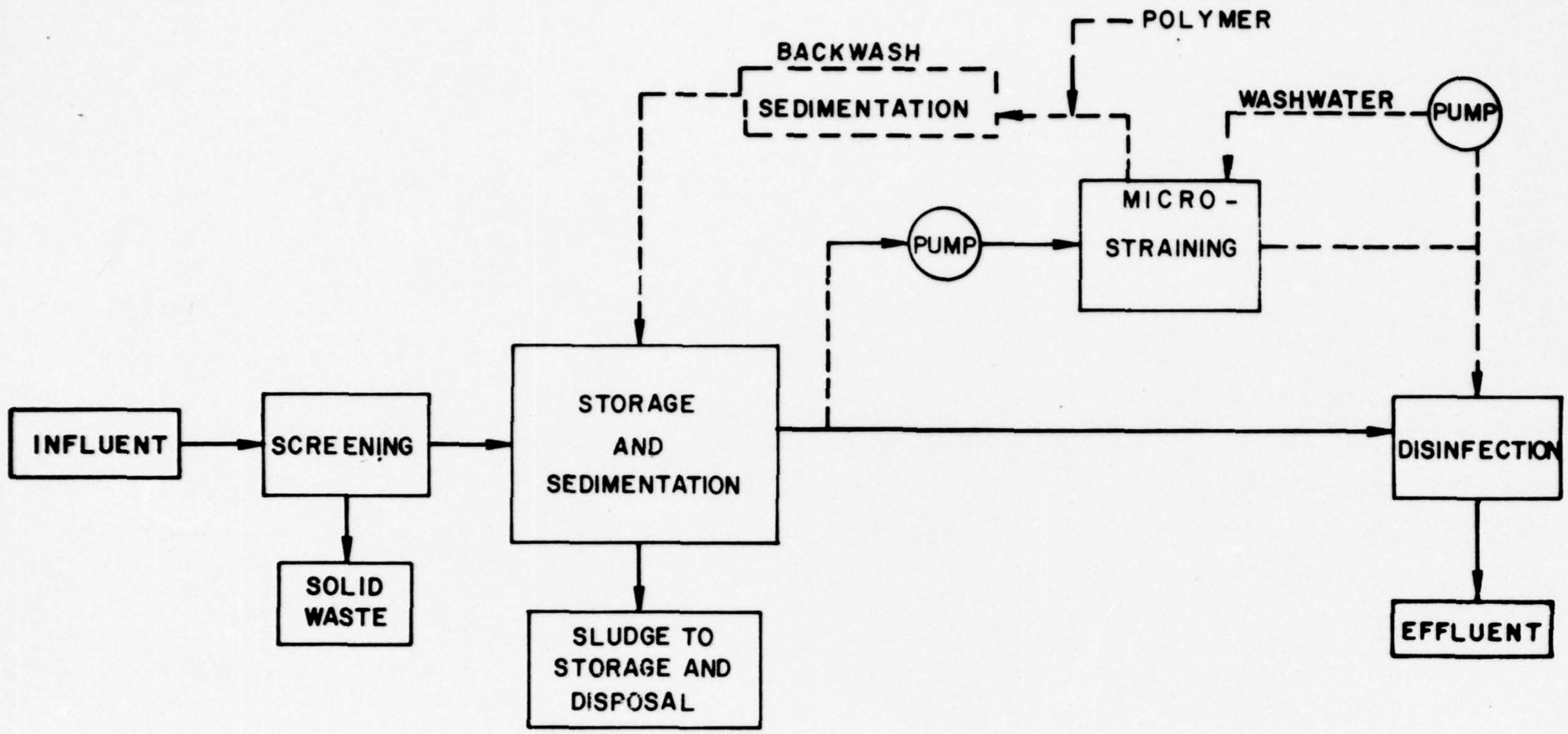
	1 Year Storm, Concept A			
Facility Designation	Storage Volume (acre ft)	Treatment Rate (cfs)	Collector Flow (cfs)	Collector Length (1,000 ft)
O-A	201	731		
O-B	348	712		
O-C	127	259		
O-D	195	398		
O-E	164	353		
O-F	13	80		
O-G	12	72		
O-H	7	45		
O-I	33	143		
O-J	4	28		
O-K	20	85		
O-L	135	276		
O-M	126	261		
O-N	173	564		
Total	9.887	15,057	9,199	93.4

Complete details on this program are contained in the Supporting Technical Reports Appendix, Annex D.

48. An optimization analysis determined that the most effective street-sweeping frequency for Omaha in reducing runoff pollution originating from the street was approximately 11 to 16 days. The evaluation was completed using the time continuous computational element of STORM for the historic hourly precipitation record at Eppley Airfield for years 1949 through 1973. The total reduction in street runoff pollution, assuming a 50 percent efficient street sweeper, would be about 30 to 40 percent.

49. A second concept involved routing urban runoff over pervious areas. A long-term analysis of precipitation intensity for Omaha indicates that drainage of impervious runoff across pervious lands could significantly reduce the average quantity of runoff from an urban area. At the same time, some reduction in runoff pollution would also be experienced. The computed reduction in impervious runoff was about 73 percent for drainage of an impervious area uniformly across an equal area of pervious land. The degree of reduction decreases with increasing precipitation intensity, and probably decreases to about zero for any major "design" storm event.

50. Another significant finding of the non-structural analysis is that streets are apparently not the major source of pollution during a runoff event. Evaluation of a 25-year historical precipitation period for Omaha (1949 to 1973), with STORM, using the results of the data acquisition program, indicates that only about 20 percent of measured urban runoff pollution may originate directly



NOTE:

PROCESS DESIGNATION

LEVEL I ————

LEVEL II – – – –

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

STORMWATER SCHEMATIC
UPSYSTEM STORAGE &
TREATMENT

LEVEL I, LEVEL 2

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

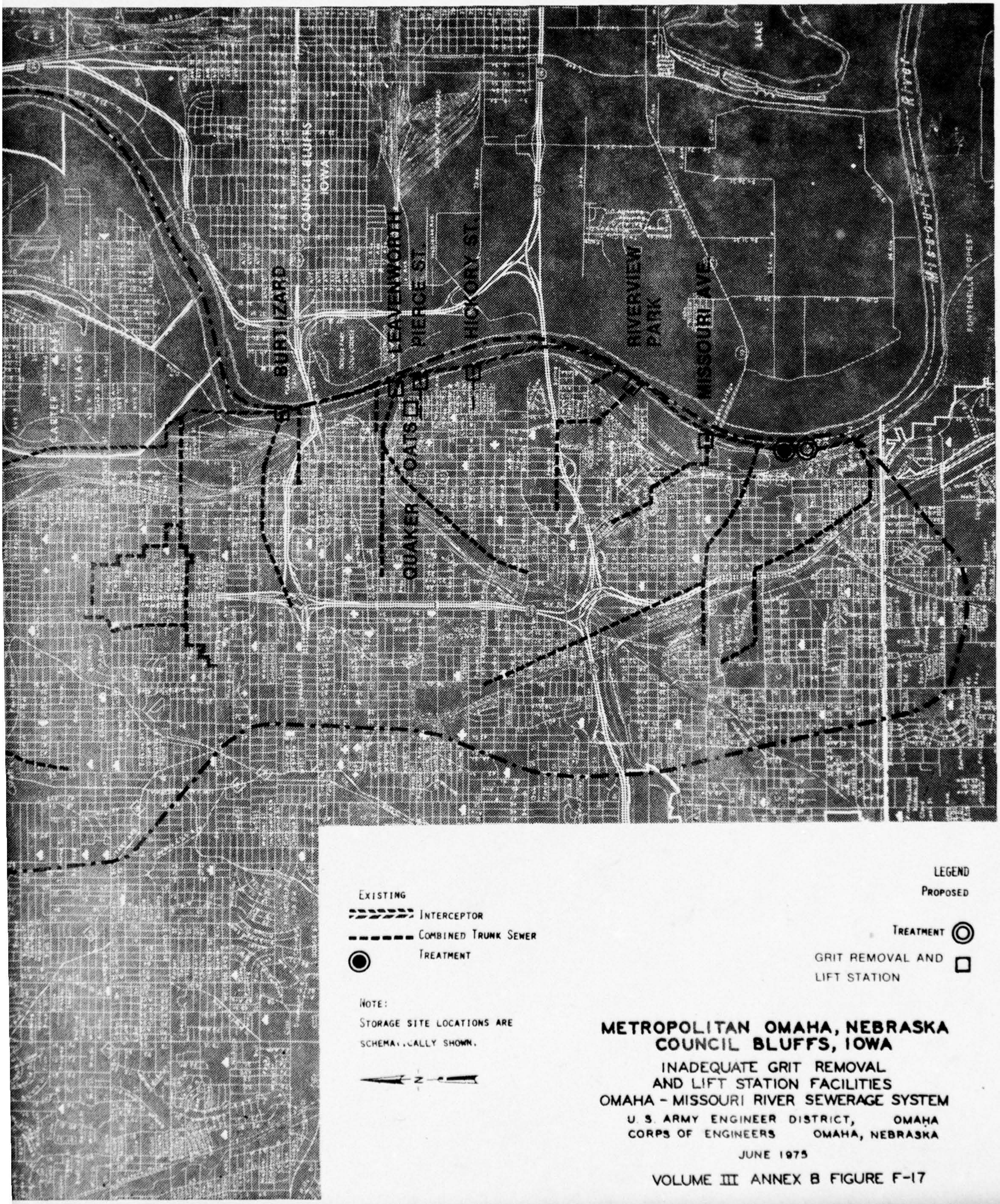
from streets. The same conclusions can be obtained using data from other studies. The principal reason is that only a very small percentage of street debris is comprised of silt, clay, and finer-sized particles. The composited results of all samples had only 11 percent of the particles finer than silt and only 0.5 percent finer than clay. Thus, even though the total quantity of debris on the street is visually quite high, one studied sector had 1,660 pounds of total debris on the street per curb mile, the actual runoff pollution potential of the debris is over-estimated. It is the fine and very fine debris that has the greatest per unit water quality impact.

Sewer System Improvements

51. As discussed previously, the Omaha-Missouri River sewerage system has reliability problems. To increase the reliability and performance of this system, provisions are required at all of the existing grit removal and pumping facilities along the interceptor to prevent dry-weather wastewater flow to the river during periods of repair or routine maintenance. Grit removal facilities and lift stations subject to breakdown are indicated on figure F-17. The major problems have occurred at the Burt-Izard and Leavenworth stations. The solution is to install dual grit removal facilities at all stations.

NORTH OMAHA AIRPORT
SKYRANCH AIRPORT
BRIDGE STREET
EPPLEY AIRFIELD
CARTER LAKE
CARTER LAKE VILLAGE
BURT-IZARD
COUNCIL BLUFFS
IOWA
FOREST LAWN CEMETERY
N. P. DODGE MEMORIAL PARK

2



LEGEND

Existing		Proposed	
Interceptor			
Combined Trunk Sewer			
Treatment		Treatment	
		Grit Removal and Lift Station	

Note:
Storage site locations are schematically shown.

N

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

INADEQUATE GRIT REMOVAL
AND LIFT STATION FACILITIES
OMAHA - MISSOURI RIVER SEWERAGE SYSTEM

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE F-17

SECTION G

EVALUATION OF SELECTED PLANS

EVALUATION OF SELECTED PLANS

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LIST OF TABLES (Cont'd)

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LIST OF FIGURES (Cont'd)

SECTION G

EVALUATION OF SELECTED PLANS

1. This section presents the results of the evaluation of the plans selected for further analysis. The selected plans provide alternative solutions to water pollution from three sources: wastewater, combined sewer overflows, and urban storm runoff.

Wastewater Management Plans

2. Four alternative wastewater management plans for abatement of pollution caused by sanitary flows have been proposed for the Omaha-Council Bluffs area. There are three basic plans plus a land treatment option for the major urban plants. This land treatment option can be used with any of the other three plans, but was used with Plan 3 for this study and evaluation. As outlined in a previous section, there are three options for Plan 3 Option. Option 2 has not been included in this final evaluation since Options 1 and 3 bracket the range of effects.

3. Plan 3 Option was developed in order to have a land treatment option for all of the major urban plants. The Council Bluffs plant will continue to provide conventional treatment in the land

treatment plan evaluated in this section. As pointed out in the previous section, the salt concentration is higher in the Council Bluffs plant effluent than for the Missouri River or Papillion Creek plants. This high salt concentration puts the SAR ratio above acceptable limits for land irrigation in Nebraska, as shown in figure F-7. The combination of the three major urban effluents brings the overall SAR ratio within acceptable limits, but the relatively low flow from the Council Bluffs plant also indicates that conveyance of the effluent across the river to join the other two major urban flows is not cost-effective. For these two reasons, Council Bluffs effluent will most likely have to be treated to a designated level and discharged to the Missouri River.

4. The four wastewater management plans and their major effects are summarized in table G-1.

IMPACT ASSESSMENT & EVALUATION OF FINAL ALTERNATIVE PLANS

5. Beneficial and adverse impacts of the four final alternative plans are evaluated and displayed in four accounts on table G-2. The national economic development (NED) account includes a measurement of the output of goods and services on a national basis. This account concludes with a computation of net NED benefits. The environmental quality (EQ) account includes measurements of changes in environmental quality. The social well-being (SWB) account includes measurements of the plan characteristics that may affect people directly. The regional development (RD) account includes a measurement of the distribution of beneficial and adverse impacts among various geographic subdivisions of the study region.

Table G-1
Summary Comparison Of Alternative Wastewater Management Plans

	Plan 1	Plan 2	Plan 3	Plan 3 Option
A. Plan Description	Papillion Creek Interceptor extended to Bennington, Elkhorn, and Gretna. 44 treatment plants: 3 major urban 7 minor urban, and 34 non-urban. All plants treat to required level of treatment and discharge to the receiving stream.	Bennington, Elkhorn, and Gretna have their own plants. 47 treatment plants: 3 major urban 10 minor urban 34 non-urban. All plants treat to required level of treatment and discharge to the receiving stream.	Land treatment by minor and non-urban plants after Level 1 treatment. Additional minor urban plant at Boys Town. Major urban plants treat to required level of treatment and discharge to Missouri River.	All plants except for the Council Bluffs plant provide Level 1 treatment and discharge to land treatment systems. Major urban plants land treatment options: 1. Blue River and Todd Valley 3. Blue River only Council Bluffs plant must provide required level of treatment and discharge to Missouri River.
B. Significant Impacts	All municipal wastewater flow will meet PL 92-500 requirements. Improved quality of area waters. Number of plants reduced from 100 to 44. Papillion Creek sewer extension promotes low density urban development.	Same as Plan 1 except that number of plants equals 47 and the smaller Papillion Creek sewer system could be used to control growth.	Same as Plan 2 except that local irrigation water supplies are supplemented and nutrients (P&N) are recycled.	Same as Plan 3.

Table G-1
(Cont'd)
Summary Comparison Of Alternative Wastewater Management Plans

	Plan 1	Plan 2	Plan 3	Plan 3 Option
Plan Evaluation				
1. Contribution to planning objectives	Meets all wastewater planning objectives.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
2. Relationship to four National accounts				
a. NED ($ million)				
(1) Beneficial impacts				
(a) Level 1	5.4	5.1	8.4	-
(b) Level 2	7.1	7.0	10.4	-
(c) Level 3	8.5	7.9	10.8	33.2 (Option 1) 34.3 (Option 3)
(2) Adverse impacts				
(a) Level 1	195.4	190.9	201.5	-
(b) Level 2	277.4	275.3	276.3	-
(c) Level 3	311.3	309.0	300.3	251.9 (Option 1) 275.0 (Option 3)
b. EQ	Improved	Improved	Improved	Improved
c. SWB				
(1) Water-related recreation	Improved	Improved	Improved	Improved
(2) Cost per customer per month				
(a) Level 1	$1.93	$1.88	$1.88	-
(b) Level 2	$2.91	$2.85	$2.85	-
(c) Level 3	$3.35	$3.32	$3.31	$3.26 (Option 1) $3.58 (Option 3)
d. RD				
(1) Net benefits ($ million)				
(a) Level 1	-190.0	-185.8	-193.1	-
(b) Level 2	-270.3	-268.3	-265.9	-
(c) Level 3	-302.8	-301.1	-289.5	-218.7 (Option 1) -240.7 (Option 3)

Table G-1
(Cont'd)
Summary Comparison Of Alternative Wastewater Management Plans

	Plan 1	Plan 2	Plan 3	Plan 3 Option
3. Plan Response to Associated Evaluation Criteria				
a. Acceptability	Acceptable by some water quality interests; not acceptable by growth control interests.	Preferred by growth control interests.	Generally acceptable.	Generally acceptable; desired in Blue River area.
b. Efficiency	Only fair at higher levels of treatment.	Only fair at higher levels of treatment.	Good-makes better use of resources by recycling nutrients.	Good-makes better use of resources by recycling nutrients, but at a higher energy use. Uses less chemicals.
c. Equity	-	-	Provides greater than Level 1 treatment for minor and non-urban plants, therefore cannot compare directly to level of treatment of Plans 1 and 2.	Same as Plan 3 for all plants except Council Bluffs plant.
d. Geographic scope	Serves 7-county area equally.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1 plus serves water-needing areas west of Omaha with irrigation water.

Table G-1
(Cont'd)
Summary Comparison Of Alternative Wastewater Management Plans

	Plan 1	Plan 2	Plan 3	Plan 3 Option
D. Implementation Responsibility				
1. Agencies involved	EPA, States of Nebraska and Iowa, and the local municipalities.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1 plus natural resources districts.
2. Initiation of plans	Local jurisdiction requests funding.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
3. Funding				
a. Capital	Nebr. / Iowa Local 12.5% / 20% State 12.5% / 5% Federal 75% / 75%	Same as Plan 1.	Same as Plan 1.	Mainly same as Plan 1 plus some additional funds may be required from land irrigation beneficiaries.
b. O&M	Local 100%	Same as Plan 1.	Same as Plan 1.	Mainly local 100% plus some additional funds from the land irrigation beneficiaries.

Table G-2
System of Accounts - Wastewater Management

	Footnotes 1/	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
I. National Economic Development												
A. Beneficial Impacts: ($ million)												
1. Value of increased outputs of goods and services.												
Irrigation	3, 5, 7, 9							1.0	1.0	1.0	10.0	10.0
Nitrogen	3, 5, 7, 9							2.3	2.3	2.3	16.7	16.7
2. Value of output from use of unemployed labor resources in construction	1, 5, 7, 9	5.4	7.1	8.5	5.1	7.0	7.9	5.1	7.1	7.5	6.5	7.6
3. Total NED Benefit		5.4	7.1	8.5	5.1	7.0	7.9	8.4	10.4	10.8	33.2	34.3
B. Adverse Impacts: ($ million)												
1. Project cost												
Papillion Creek		77.4	114.9	122.8	68.5	106.3	112.4	70.5	106.3	111.6	94.5	109.0
Missouri River		65.3	93.4	107.0	69.6	99.7	114.9	69.6	99.7	114.9	83.6	92.2
Council Bluffs		23.7	32.5	36.0	23.8	32.7	36.2	23.8	32.7	36.2	36.2	36.2
Additional areas		29.0	36.6	45.5	29.0	36.6	45.5	37.6	37.6	37.6	37.6	37.6
Total project cost	3, 5, 7, 9	195.4	277.4	311.3	190.9	275.3	309.0	201.5	276.3	300.3	251.9	275.0
2. Total NED cost		195.4	277.4	311.3	190.9	275.3	309.0	201.5	276.3	300.3	251.9	275.0
C. Net NED Benefit		-190.0	-270.3	-302.8	-185.8	-268.3	-301.1	-193.1	-265.9	-289.5	-218.7	-240.7
II. Environmental Quality												
A. Water Quality:												
1. Ground water	2, 4, 8, 10	See Text - Paragraph 18.										
2. Surface water												
a. Pollutant loads (1995) (1000 tons/year)	3, 5, 8, 9											
(1) SS		5.2	3.1	0.4	5.2	3.1	0.4	4.9	2.9	0.4	0.2	0.2
(2) BOD		4.1	2.1	1.0	4.1	2.0	1.0	3.9	1.8	1.0	0.6	0.6
(3) PO_4		1.0	0.25	0.02	1.0	0.25	0.02	1.0	0.25	0.02	0.01	0.01
(4) N (total)		4.9	4.7	1.2	4.8	4.7	1.2	4.6	4.5	1.1	0.7	0.7

1/ Footnotes indexed at end of table G-22

Table G-2
(Cont'd)
System of Accounts - Wastewater Management

	Footnotes[1/]	Plan 1 Level 1	Plan 1 Level 2	Plan 1 Level 3	Plan 2 Level 1	Plan 2 Level 2	Plan 2 Level 3	Plan 3 Level 1	Plan 3 Level 2	Plan 3 Level 3	Plan 3 Option: Option 1	Plan 3 Option: Option 3
b. Stream Quality (2020) (mg/1)	3, 5, 8, 9											
(1) Missouri River (6000 cfs)												
(a) SS		49	48	48	49	48	48	49	48	48	50	50
(b) DO		5-6	6-7	6-7	5-6	6-7	6-7	5-6	6-7	6-7	6-7	6-7
(c) PO_4		0.38	0.15	0.13	0.38	0.15	0.13	0.38	0.15	0.13	0.13	0.13
(d) Ammonia N		0.9	0.1	0.1	0.9	0.1	0.1	0.9	0.1	0.1	0.1	0.1
(2) Big Papio (4 cfs)												
(a) SS		50	50	50	46	45	43	50	50	50	50	50
(b) DO		7	7	7	2-7	6-7	7	7	7	7	7	7
(c) PO_4		0.16	0.16	0.16	1.21	0.41	0.15	0.16	0.16	0.16	0.16	0.16
(d) Ammonia N		0.1	0.1	0.1	2.7	0.3	0.1	0.1	0.1	0.1	0.1	0.1
(3) West Papio (0.5 cfs)												
(a) SS		50	50	50	33	27	20	50	50	50	50	50
(b) DO		7	7	7	0-7	4-7	7	7	7	7	7	7
(c) PO_4		0.16	0.16	0.16	4.67	1.24	0.12	0.16	0.16	0.16	0.16	0.16
(d) Ammonia N		0.1	0.1	0.1	11.1	1.0	0.2	0.1	0.1	0.1	0.1	0.1
c. Biological life	2, 4, 8, 10											
(1) Improvement in aquatic species diversity		See Text - Paragraph 21										
(2) Effect on terrestrial species		See Text - Paragraph 22										
(3) Effect on waterfowl		See Text - Paragraph 23										
B. Air Quality	2, 4, 8, 10	See Text - Paragraphs 24 and 25										
C. Land Quality												
1. Physical												
a. Number of treatment plants	1, 6, 7, 9	44	44	44	47	47	47	48	48	48	48	48
b. Length of conveyance facilities (miles)	1, 6, 7, 9	89	89	89	73	73	73	132	132	132	195	195

1/ Footnotes indexed at the end of table G-22

Table G-2
(Cont'd)
System of Accounts - Wastewater Management

	Footnotes 1/	Plan 1 Level 1	Plan 1 Level 2	Plan 1 Level 3	Plan 2 Level 1	Plan 2 Level 2	Plan 2 Level 3	Plan 3 Level 1	Plan 3 Level 2	Plan 3 Level 3	Plan 3 Option: Option 1	Plan 3 Option: Option 3
c. Land requirements in 2020 (acres)	1, 6, 7, 9											
(1) Irrigation												
(a) 15"/year		0	0	0	0	0	0	18,018	18,018	18,018	165,759	165,759
(b) 33"/year		0	0	0	0	0	0	8,190	8,190	8,190	75,345	75,345
(2) Storage		0	0	0	0	0	0	665	665	665	3,615	3,615
d. Land treatment impacts	2, 5, 8, 10											
(1) Runoff potential		See Text - Paragraph 28.										
(2) Water table rise		See Text - Paragraph 28.										
(3) Erosion increase		See Text - Paragraph 28.										
e. Construction impacts	1, 5, 8, 9	See Text - Paragraph 29.										
f. Corn production increase (1,000 bu/yr)	2, 4, 8, 10	0	0	0	0	0	0	216	216	216	2,582	3,171
2. Chemical												
a. Concentration of salts and chemicals in soil	2, 5, 8, 9	See Text - Paragraph 32.										
b. Amount of nitrogen fertilizer provided (tons/yr)	1, 5, 7, 9											
1985		0	0	0	0	0	0	318	318	318	3,038	3,038
2020		0	0	0	0	0	0	560	560	560	5,744	5,744
III. Social Well-Being												
A. Water-Related Recreation	2, 5, 8, 9	See Text - Paragraph										
B. Treatment Costs (1995) ($/customer-month)	2, 5, 7, 9											
1. Energy (@ $.01 kw-hr)		0.25	0.36	-	0.25	0.36	-	0.26	0.37	-	0.96	1.42
2. Chemicals		0.56	1.11	-	0.56	1.11	-	0.56	1.09	-	0.66	0.66

1/ Footnotes indexed at the end of table G-22

Table G-2
(Cont'd)
System of Accounts - Wastewater Management

	Footnotes[1]	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
3. Total cost												
a. Cost per month		1.93	2.91	3.35	1.88	2.85	3.32	1.88	2.85	3.31	3.26	3.58
b. Percent of income		0.2	0.3	0.4	0.2	0.3	0.4	0.2	0.3	0.4	0.4	0.4
C. Nitrogen Recycle Benefit (1995) ($/customer-month)	2, 5, 8, 10	0	0	0	0	0	0	.06	.06	.06	.48	.48
IV. Regional Development												
A. Economic Impacts	3, 5, 7, 9	See tables G-3 through G-13 for distribution of the economic impacts. See table G-14 for beneficial impact on employment in the region.										
B. Area Growth and Development	2, 5, 8, 10	See Text - Paragraph 46.										

[1] Footnotes indexed at the end of table G-22.

Table G-3
Regional Economic Development
Plan 1 Level 1

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					5.4					5.4
Total Benefits					5.4					5.4
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	39.2	34.0	14.5	14.6	102.3		0.9	11.5	80.7	195.4
Net Benefits (Total Benefits-Project Costs) ($ millions)					-96.9		-0.9	-11.5	-80.7	-190.0

Table G-4
Regional Economic Development
Plan 1 Level 2

	Planning Area					Outside Planning Area				
							State			
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	Iowa	Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.1					7.1
Total Benefits					7.1					7.1
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	61.7	51.0	20.9	18.8	152.4		1.0	15.5	108.5	277.4
Net Benefits (Total Benefits-Project Costs) ($ millions)					-145.3		-1.0	-15.5	-108.5	-270.3

Table G-5
Regional Economic Development
Plan 1 Level 3

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	State
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					8.5					8.5
Total Benefits					8.5					8.5
Adverse Impacts: ($ millions)										
Project Costs-Total Cost	65.0	59.2	22.1	21.8	168.1		1.3	17.4	124.5	311.3
Net Benefits (Total Benefits-Project Costs) ($ millions)					-159.6		-1.3	-17.4	-124.5	-302.8

Table G-6
Regional Economic Development
Plan 2 Level 1

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					5.1					5.1
Total Benefits					5.1					5.1
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	37.0	36.0	14.6	14.6	102.2		0.9	10.8	77.0	190.9
Net Benefits (Total Benefits-Project Costs ($ millions)					-97.1		-0.9	10.8	-77.0	-185.8

Table G-7
Regional Economic Development
Plan 2 Level 2

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.0					7.0
Total Benefits					7.0					7.0
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	60.1	54.0	21.0	18.8	153.9		1.0	14.9	105.5	275.3
Net Benefits (Total Benefits-Project Costs ($ millions)					-146.9		-1.0	-14.9	-105.5	-268.3

Table G-8
Regional Economic Development
Plan 2 Level 3

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water										
Irrigation - Nitrogen										
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.9					7.9
Total Benefits					7.9					7.9
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	61.4	63.3	22.2	21.8	168.7		1.3	17.1	121.9	309.0
Net Benefits (Total Benefits-Project Costs ($ millions)					-160.8		-1.3	-17.1	-121.9	-301.1

Table G-9
Regional Economic Development
Plan 3 Level 1

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water				1.0	1.0					1.0
Irrigation - Nitrogen				2.3	2.3					2.3
Value of output from use of unemployed or underemployed labor resources in construction or installation					5.1					5.1
Total Benefits					8.4					8.4
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	38.1	36.0	14.6	19.5	108.2		1.0	11.2	81.1	201.5
Net Benefits (Total Benefits-Project Costs ($ millions)					-99.8		-1.0	-11.2	-81.1	-193.1

Table G-10
Regional Economic Development
Plan 3 Level 2

	Planning Area					Outside Planning Area				
							State			
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	Iowa	Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water				1.0	1.0					1.0
Irrigation - Nitrogen				2.3	2.3					2.3
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.1					7.1
Total Benefits					10.4					10.4
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	60.1	54.0	21.0	19.5	154.6		1.1	15.0	105.6	276.3
Net Benefits (Total Benefits-Project Costs ($ millions)					-144.2		-1.1	-15.0	-105.6	-265.9

Table G-11
Regional Economic Development
Plan 3 · Level 3

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water				1.0	1.0					1.0
Irrigation - Nitrogen				2.3	2.3					2.3
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.5					7.5
Total Benefits					10.8					10.8
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	61.0	63.3	22.2	19.5	166.0		1.3	16.5	116.5	300.3
Net Benefits (Total Benefits-Project Costs ($ millions)					-155.2		-1.3	-16.5	-116.5	-289.5

Table G-12
Regional Economic Development
Plan 3 Option 1

	Planning Area					Outside Planning Area				
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	State Iowa	State Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water				1.0	1.0	9.0*				10.6
Irrigation - Nitrogen				2.3	2.3	14.4*				16.7
Value of output from use of unemployed or underemployed labor resources in construction or installation					6.5					6.5
Total Benefits					9.8	23.4*				33.2
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	48.0	43.7	22.2	19.5	133.4		1.3	14.2	103.0	251.9
Net Benefits (Total Benefits-Project Costs ($ millions)					-123.6	23.4*	- 1.3	-14.2	-103.0	-218.7

* Includes Todd Valley Benefits

Table G-13
Regional Economic Development
Plan 3 Option 3

	Planning Area					Outside Planning Area				
							State			
	Papillion Creek	Missouri River	Council Bluffs	Additional Areas	Total Plan Area	Blue Valley	Iowa	Nebr	Federal	Total
Beneficial Impacts: ($ millions)										
Value of increased output of goods and services										
Irrigation - Water				1.0	1.0	9.0				10.0
Irrigation - Nitrogen				2.3	2.3	14.4				16.7
Value of output from use of unemployed or underemployed labor resources in construction or installation					7.6					7.6
Total Benefits					10.9	23.4				34.3
Adverse Impacts: ($ millions)										
Project Costs-Total Costs	55.4	50.2	22.2	19.5	147.3		1.3	15.5	110.9	275.0
Net Benefits (Total Benefits-Project Costs ($ millions)					-136.4	23.4	-1.3	-15.5	-110.9	-240.7

Table G-14
Effect of Treatment Level on Employment*

Plant Location	Treatment Level: Level 1	Levels 2 or 3
Missouri	Create 24 additional highly skilled or semi-skilled jobs. Create 16 additional unskilled jobs.	Create 48 additional highly skilled or semi-skilled jobs. Create 28 additional unskilled jobs.
Papillion Creek	Create 28 additional highly skilled or semi-skilled jobs. Create 18 additional unskilled jobs.	Create 56 additional highly skilled or semi-skilled jobs. Create 32 additional unskilled jobs.
Council Bluffs	- - -	Create 8 additional highly skilled or semi-skilled jobs. Create 4 additional unskilled jobs.
Additional Areas	Create 8 additional highly skilled or semi-skilled jobs.	Create 16 additional highly skilled or semi-skilled jobs.

* Total increase in employment from 1975 levels of employment at 1975 levels of treatment.

NATIONAL ECONOMIC DEVELOPMENT (NED)

6. Beneficial NED Impacts. Beneficial NED impacts include the value of increased output of goods and services in the form of irrigation water and nitrogen and the value of output from the use of unemployed labor resources in construction. The irrigation benefits occur only when land irrigation is included in a plan.

7. The benefits are the savings that would be realized by the farmer if he were to use the wastewater instead of obtaining water from an irrigation well or wells. Savings realized by the farmer would be:

- The cost of drilling an irrigation well;
- Part of the cost of an irrigation pump;
- Part of the cost of an irrigation engine;
- Interest on investment;
- Fertilizer costs;
- Irrigation labor;
- Maintenance and repairs on irrigation equipment; and
- Fuel.

8. The irrigation savings were computed for a 160-acre center-pivot irrigator. The savings, or benefits, were then broken down

to a per acre savings, assuming 133 acres of the 160 acre field could be covered by the irrigator. The per acre savings were then converted to annual dollar amounts by a staging system whereby the number of acres being irrigated are increased by a certain amount at 5-year intervals. These savings were then converted to a present-worth value.

9. The savings for fertilizer would result from the recycle of nitrogen to the land treatment areas. The benefit was computed based on a 15-inch per acre application rate for the irrigation water. This would recycle about 100 pounds of nitrogen per acre per year. The present cost for nitrogen is 30 cents per pound, and this amount was used to compute the benefit for the nitrogen. Since 155 to 160 pounds of nitrogen are required to raise a corn crop (100 bushels per acre), additional nitrogen will be required equivalent to the amount presently used minus 100 pounds per acre. No savings were included for the addition of phosphorous due to the low amount of phosphorous used in the land application areas.

10. A category under NED benefits, "Value of Output Resulting from External Economics", was not shown in table G-2 since no value could be placed on this category. This is not to imply that there are no such economic considerations. Improved water quality will have some definite economic impacts, some of which will be of the nature of an external economy. Examples of such benefits on which values cannot be placed are:

Improved water quality in the Missouri River which could result in increased recreational use which in turn could increase demand for water-recreation related goods and services, an external economy.

Reduced water treatment costs for lowering the pollutant levels of the water for industrial users and municipal systems located downstream.

11. Another benefit would be the value of use of unemployed labor resources in construction of the new facilities. The value of this benefit was arrived at by assuming that 50 percent of the capital expenditure would be for labor and that 10 percent of the labor force would be from the unemployed ranks.

12. Adverse NED Impacts. The adverse impacts consist entirely of the project costs. The project costs are the present worth costs of the plans, broken down into four categories, Papillion Creek, Missouri, Council Bluffs, and "Additional Areas". The Papillion Creek category always includes the minor urban community costs for Gretna, Bennington, and Elkhorn. The "Additional Areas" category refers to the seven other minor urban plants and the non-urban treatment plants.

13. Included in the costs for the conventional treatment plans, Plans 1 and 2, are the present worth values for the capital and O&M costs for the treatment plants and interceptors. Plan 3 costs include the costs for conventional treatment at the major urban plants and the land treatment costs for the minor and non-urban communities. The land treatment costs include the costs for Level 1 treatment, conveyance to the land treatment sites, purchase of the land, underdraining the land, storage facilities, and irrigation facilities. Plan 3 Option costs include the costs for conventional treatment at the Council Bluffs plant and land treatment for the other plants. The minor and non-urban costs for

land treatment are the same as those used in Plan 3. The major urban costs associated with Plan 3 Option are not as inclusive as those for the minor and non-urban communities. The only costs included are the costs for secondary treatment and the costs associated with conveyance to the irrigation facilities. These latter costs include the costs of conveyance, storage, pumping to the irrigators. Since irrigation is presently practiced in the land treatment areas, it was assumed that private ownership should continue and that the treated effluent would become the irrigation water. Underdrainage was not included since the depths to ground water are presently 60 to 200 feet in the major urban land treatment areas.

13a. Facilities for treatment Levels 1 and 2 were assumed to be in place by 1977. The present worth costs for these treatment levels therefore represent the time frame from 1977-2020. Facilities for treatment Level 3 and the land treatment portions of the plans were initiated in 1985. The present worth costs for Level 3 treatment and the land treatment options represent the costs of Level 1 (secondary) treatment from 1977 to 1985 and Level 3 (zero discharge) treatment from 1985 to 2020. This represents a time phasing of facilities to meet the 1985 goal of PL 92-500. Annex H of Volume V contains the capital and operation and maintenance expenditures at various dates for each plan and each treatment level. If Level 2 is implemented at a later date, the present worth costs would be less. For example, if Level 2 is implemented in 1983 the Level 2 present worth costs would be reduced by about $20.5 million for Plans 1, 2, and 3 in table G-1.

14. Since Plan 1 would encourage urban sprawl and Plans 2, 3, and Plan 3 Option will not, Growth Concept A costs were used for Plan 1 and Growth Concept C costs were used for Plans 2, 3, and 3 Option.

15. Net NED Impacts. Total NED costs were subtracted from total NED benefits in order to obtain the net NED benefits. The resulting values were all negative and indicate that the NED benefit decreases as treatment level goes up for each plan.

16. NED Plan. The NED plan is the plan with the highest net NED benefit. Since Level 1 treatment at the major urban plants appears to be all that is required (discussed under environmental quality) and the major urban costs make up the major portion of the project costs, Plan 2 (Level 1) is the NED plan. If "zero discharge" is required, then one of the land treatment options becomes the NED plan.

ENVIRONMENTAL QUALITY (EQ)

17. The environmental impacts of the four wastewater management plans are summarized in table G-2. The impacts on water, land, and air quality were evaluated.

18. Water. Ground-water quality should not be affected under any of the plans. Depth to the ground-water table ranges from 60 to 200 feet in the land irrigation areas. Approximately 5 feet of soil under an application rate of 1 to 4-inches per week is required to provide a high degree of wastewater renovation. Application at a rate of 15-inches per year should not create adverse impacts in ground-water quality and may produce beneficial effects as discussed later.

19. Surface water quality is noticeably affected by the wastewater. As the level of treatment increases, the pollutant load decreases. This produces a noticeable effect on the streams in the Papillion Creek system. The best way to show this effect was to estimate the change in water quality of the streams using the wastewater concentrations of certain parameters and the corresponding concentrations in the stream prior to the entry of the wastewater. The stream quality values, before wastewater discharge, were obtained from STORET data on the streams. An arbitrary initial suspended solids value of 50 mg/l was also used. The base values for ammonia-nitrogen and phosphorous used for West Papillion Creek were assumed to be the same as those used for Big Papillion Creek. The final pollutant levels were arrived at by multiplying the concentrations of the pollutants in the wastewater and streams by their corresponding flows, summing these products, and dividing by the sum of the flows. The effects of the wastewater were more

pronounced in the two Papillion Creek branches than the Missouri River since they had lower base flows for dilution. The stream water quality values are those for low-flow conditions so that they reflect the worst conditions that could occur.

20. The stream quality values indicate Missouri River quality is not greatly affected by Level 1 treatment discharges. The smaller streams, Big and West Papillion Creeks, are noticeably affected. It appears that Level 2 treatment will be required at Bennington and Elkhorn in order to keep the DO, phosphorous, and ammonia levels at desirable levels. This would be required in Plan 2 only since the other three plans treat to higher levels or else discharge directly to the Missouri River.

21. The biological life of the streams in the area would be affected. There should be some improvement in diversity of aquatic species. As the level of treatment increases, more improvement should be noted. Only moderate improvement would be noted at best since there are other sources of pollution other than wastewater from treatment plants. Also, the diversity of species currently present is so low that drastic changes in diversity probably would not occur. In Plan 1, the removal of all treatment plant flows from the Papillion Creek system should show moderate improvement no matter what level of treatment is practiced. Under the land treatment plans, Plan 3 and Plan 3 Option, all treatment plant flow would be removed from the smaller streams so that more diversity of aquatic species should occur than under discharges of effluent to the streams.

22. Terrestrial biological life should be affected primarily by the construction of the wastewater management system selected. The main impacts should be noticed in areas where interceptor and pipeline construction occurs. More pipelines and interceptors are required for the land treatment plans and Plan 1. With proper management, the pipeline construction required for Plan 3 Option could improve the environment for wildlife species in the future. The linear configuration of the pipeline route lends itself to a situation, where, with plantings of native grasses and woody plant species, many miles of "edge" habitat could be provided. "Edge" habitat provides an interface with other habitat types, a condition which is highly beneficial to maintaining diverse wildlife populations. A long-term easement of the pipeline route would maximize the benefits. Buffer zones around the storage lagoons in the land treatment plans could provide a needed habitat for small wildlife species.

23. Waterfowl should not be adversely affected under any of the plans. As the area waters are cleaned up by the improved wastewater treatment, waterfowl should benefit. Under the land treatment plans, the storage lagoons for the wastewater should provide more wetland habitat for the waterfowl.

24. Air. Air quality would not be appreciably affected under any of the plans. There is a possibility that a slight odor problem could exist in land disposal areas, but proper Level 1 treatment and land disposal procedures should keep this to a minimum.

25. Air quality in the vicinity of the major urban treatment plants could be adversely affected by the discharge from the

incinerators used to destroy the organic portion of the sludges produced during wastewater treatment. As the level of treatment increases, the amount of sludge will increase, requiring larger incinerators and more discharge. Proper equipment and operation should keep the air pollution potential to a minimum.

26. Land. Plans 1 and 2 would not have any appreciable effect on the existing land quality. The only effects that would occur would be to the land taken for treatment facilities and for construction of the conveyance pipelines.

27. Plans 3 and 3 Option would have some major effects on the land quality within the seven-county area as well as at the major urban wastewater irrigation sites. The land at the disposal sites would be affected as well as strips of land to these sites where the pipelines are constructed. The amount of land affected ranges from about 9,000 acres to 170,000 acres, depending upon the treatment rate used and the plan used.

28. A major factor in determining the impacts of land treatment is the land treatment application rate. Runoff and erosion potentials increase as the application rate increases. The rise in the level of ground water increases as the treatment rate increases. In the case of the Blue River Basin, this latter effect is desirable since the ground-water table is presently declining.

29. Construction impacts are higher for the plans which call for more pipelines since the construction of the pipelines would be disruptive to the environment during construction and for a period of years after construction. As discussed previously, proper

construction and use of the pipeline and its right-of-way should minimize and, in the long run, enhance the environment for wildlife.

30. Wastewater irrigation has a positive effect on the amount of crops that could be produced. The increased water and nutrient levels should improve the quantity of crops produced per acre. Based on "Nebraska 1973 - Preliminary County Estimates and State Agricultural Data", an increase in corn production can be computed for the land treatment areas. In the minor urban disposal areas, irrigation of corn resulted in an increased production of 24 bushels per acre. Increases of 28 bushels per acre in the Todd Valley and 40 bushels per acre in the Blue River basin were recorded. More land could also be used for production if water was made available in areas presently lacking adequate water for crops.

31. An estimate of the increase in corn production is presented in table G-2. The figures presented are based on the increase in yields for the three land treatment areas presented in the previous paragraph. It was assumed that 50 percent of the irrigated land will be in corn for the first time.

32. The application of wastewater effluent to land has an effect on the chemical properties of the soil. If the salt concentrations are too high, concentration of the salts in the soil could increase to levels that would make the land unsuitable for crop production. On the positive side, the nutrients recycled by wastewater irrigation would result in a lower need for commercial fertilizers for crop production. The wastewater nutrients are applied at a slow,

continuous rate prior to and during the growing season. Therefore, the nitrogen that is applied by wastewater irrigation should be used more efficiently than the fertilizer nutrients, which are applied once a year. The overall amount of nutrients required to produce the crop could be decreased since those applied are used more efficiently. An example of the inefficiency of the application of commercial fertilizers is the loss of fertilizer that occurs under spring application followed by heavy rains. It has also been reported that one-third of all applied nitrogen fertilizer is changed to nitrogen gas and released to the atmosphere, thereby adding to the loss of commercial fertilizer.

33. EQ Plan. The EQ plan is the plan with the highest net environmental benefit. For wastewater management, the EQ plan is Plan 3 Option with either Option 1 or 3 being the EQ option. This plan results in zero discharge of pollutants while recycling water for irrigation to water needing areas and nutrients for crop production. The study area and the land treatment area for the major urban plants will both benefit under Plan 3 Option. Under an application rate of 15-inches per year, no significant adverse effects should occur.

SOCIAL WELL-BEING (SWB)

34. The social well-being impacts include the value of plan characteristics which are felt directly by the individual. These impacts can affect the individual by altering his living conditions or by changing his living expenses.

35. The first impact shown in the display under social well-being affects living conditions. Better wastewater treatment will improve

the area waters for water-related recreation purposes. The higher the level of treatment, the greater the improvement. The types of water-related recreation that would improve would most likely be fishing, boating, picnicking, and sight-seeing. Body contact recreation is highly unlikely due to the high summer flow of the river which is maintained for barge traffic.

36. Other social well-being impacts can best be depicted by indicating the effects on the living expenses of the residents of the study area. Total treatment costs per customer per month are shown for the four wastewater management plans. These costs reflect only those costs which could be incurred by sewage treatment for domestic flows. The total costs were distributed between residential and industrial customers based upon the average daily flows of both customers. The actual costs incurred by industry should be based upon pollutant loadings as well. The costs cannot be compared directly to present sewer bills since the present sewer bills are for all sewage treatment costs as well as sewer construction and maintenance costs. Present sewage treatment billings average about $4 per customer per month. The costs shown in table G-2 are average monthly costs for 1995 and these costs could increase the average monthly sewer bill by $1.88 to $3.58, depending on the plan and treatment level.

37. The costs for energy and chemicals are presented in table G-2 to show that they comprise a significant portion of the operation and maintenance costs, and in turn, the average monthly cost. It is interesting to note that from about 85 to 95 percent of the average monthly cost is for O&M. Since the local portion of the capital costs is only 12.5 percent of the total capital costs, the monthly capital cost per customer is low.

38. Since energy use is becoming more critical from an energy shortage standpoint, the amount of energy to be used in wastewater treatment could affect the amount of energy available to the citizens of the study area. The conventional treatment plans for the major urban plants, Plans 1, 2, and 3 are the most energy conserving plans. The Plan 3 Option alternatives require high use of energy for pumping the effluent to the land treatment areas.

39. The use of chemicals should be minimized in order to conserve the natural resources of the world. Plan 3 Option is more chemical conserving than the other three plans at the higher levels (Levels 2 and 3) of treatment.

40. To show the value of nitrogen that would be recycled in land treatment instead of being wasted, a per customer per month cost savings is shown in the social well-being account. If the farmers were willing to pay the treatment plants the present rate for nitrogen, the reductions in the study area treatment costs would be those shown.

REGIONAL DEVELOPMENT (RD)

41. The Regional Development account, tables G-3 through G-13, shows the impacts of the alternative plans on the various regions in and out of the study area. As with the NED account, it is difficult to put cost figures on several benefits, particularly improved water in the lakes and streams of the region. Since the beneficial impacts in dollar terms are low and the net benefits are the difference between beneficial impacts and the adverse impacts, the net benefits are negative within the planning area.

42. The only beneficial impacts that could be assigned monetary values are increased irrigation water, nitrogen recycle, and output from the use of unemployed labor. The value of increased irrigation water was determined by computing the savings by the irrigator resulting from supplying water at the irrigating rig so that he would not need to drill a well and pump the water out of the ground. Beneficial impacts from nitrogen accrue since less nitrogen fertilizer would need to be purchased. Unemployed labor would be used to construct the facilities so that a portion, 5 percent, of the capital costs are applied to this category.

43. The adverse impacts are the present worth costs associated with the implementation and operation of the plans in the planning period. These costs are distributed among the appropriate treatment plants.

44. Regional development impacts would be felt within and outside of the study area. State and Federal spending would cause adverse impacts at those levels. The areas which would receive the treated wastewater for irrigation would benefit from the increased irrigation water and nitrogen.

45. The distribution of the adverse impacts among the various agencies was determined. The capital costs would be incurred by three agency levels; local, State, and Federal (nation). In Nebraska, the local share is 12.5 percent, the State share is 12.5 percent, and the Federal share is 75 percent. In Iowa, the local share is 20 percent, the State share is 5 percent, and the Federal share is 75 percent. All O&M costs are incurred at the local level.

46. Growth and development in the study area would be influenced by the different wastewater management plans. Plan 1 would induce urban sprawl in western Omaha. The other plans would tend to discourage sprawl and encourage constrained growth since the interceptors would not be extended so far out in the rural areas. Rural development would be enhanced within the study area as well as in the major urban land irrigation areas under Plan 3 Option. Increased irrigation water in those areas could result in more land in production and better crop production, both of which would stimulate development in those areas.

47. The best plan from a net economic impact standpoint varies, depending upon the level of treatment required. Plan 2, with a net economic benefit of minus 185.8 million appears to be the best for Level 1 treatment. At higher levels of treatment, land irrigation appears to be the best method of treatment for the entire study area. All of the options under Plan 3 Option have lower negative net benefits than do any of the other plans at Levels 2 and 3. This plan also has the most desirable impact from an area growth and development standpoint since outside areas are benefitted along with the study area.

48. Transmission pipelines to the major land irrigation areas are sized to handle 2020 flows. Since the pipeline cannot be phased, it represents a large initial investment which could bias the economics of the Land Treatment Options. An analysis was performed to use the full capacity of the pipeline by pumping part effluent and part Missouri River water. This was labeled Option 4. Option 4 was found to be economically infeasible. The present worth of additional benefits equaled $4.3 million with additional present worth costs of $20.1 million.

49. The costs shown for the minor urban and non-urban land treatment options are somewhat higher than those that may actually be incurred. The costs given are for purchasing land, underdraining it, and applying the wastewater with purchased equipment. In actuality, the costs may need to include only the cost to treat to Level 1 and transport the wastewater to the disposal site. If the latter is the case, the costs presented in this evaluation can be reduced. The costs presented for the major urban land treatment schemes include only the latter costs.

TREATMENT LEVEL EVALUATION

50. Water quality planning, since the passage of PL 92-500, has had two distinct goals: (1) protect and maintain State water quality standards, which assume use of the receiving streams to complete the treatment process, but not in a degree to measurably harm fish life; and (2) "zero-discharge" which assumes that streams, lakes, and rivers are not to be part of the sewage disposal process. The latter is the 1985 stated goal of Congress; the former is acknowledged in the 1977 and 1983 requirements of PL 92-500. Much controversy and debate have centered around the two goals.

51. Under PL 92-500, Congress created the National Commission on Water Quality to determine if all the requirements and goals of the law are practical and if they can be implemented. The Commission's report will be completed by 1976.

52. Part of the purpose of the wastewater planning undertaken in the Omaha-Council Bluffs study was to determine the best methods of achieving the goals and requirements of PL 92-500 and to identify

the impacts as best as possible. Based on the costs and impacts developed to date, it would appear that, for the Omaha-Council Bluffs area, Level 1 treatment for domestic waste sources would meet water quality standards for all treatment plants that discharge to the Missouri River. Some treatment plants that discharge into smaller streams would require Level 2 treatment when Nebraska's and Iowa's basin (303e) water quality studies are completed.

COSTS

53. For the plans employing conventional treatment plants, the present worth cost difference between Level 1 and Level 2 treatment is approximately $42 million. If Level 2 treatment is delayed until 1983, the present worth difference is approximately $62 million. The present worth cost difference between Level 1 and Level 3 treatment is approximately $120 million with Level 3 treatment being implemented at 1985.

54. For Plan 3 - Land Treatment Option 1, the present worth cost difference between Level 1 and Level 3 treatment is approximately $56.5 million and for Option 3 is approximately 80 million. The present worth cost assumes land irrigation from 1985 thru 2020.

IMPACTS

55. Water Quality. As the level of treatment increases, the water quality of the streams improves. The water quality of the streams is dependent on the base flow of the streams and the amount of pollutants being discharged into them.

56. In order to determine the level of treatment required to meet water quality standards, stream modeling of dissolved oxygen levels was performed. The effects of the wastewater on the DO level of the Missouri River was determined at two flows, 25,000 c.f.s. and 6,000 c.f.s. The 25,000 c.f.s. represents the summer normal flow of the Missouri River at Omaha. The 6,000 c.f.s. represents the projected 2020 minimum flow, based on operational studies of the Missouri River with maximum ultimate development of the river as a water supply source.

57. Figure G-1 shows that the dissolved oxygen standard of 5 mg/l for the Missouri River is met at summer normal flow and temperature conditions with Level 1 treatment. Under normal conditions and with current analysis techniques, there would appear to be little merit in requiring treatment levels above secondary. The standard also was not contravened for low flow (6,000 c.f.s.) and low temperature conditions (10° C). Figure G-1 shows that future withdrawals of water from upstream locations would require that Level 2 treatment be implemented to meet water quality standards at the low-flow, high-temperature conditions.

58. Little and Big Papillion Creeks are used as wastewater discharge streams in Plan 2. Since these are low-flow streams, at least Level 2 treatment at Bennington and Elkhorn would be required in order to keep DO and ammonia concentrations at desirable levels in these streams under Plan 2.

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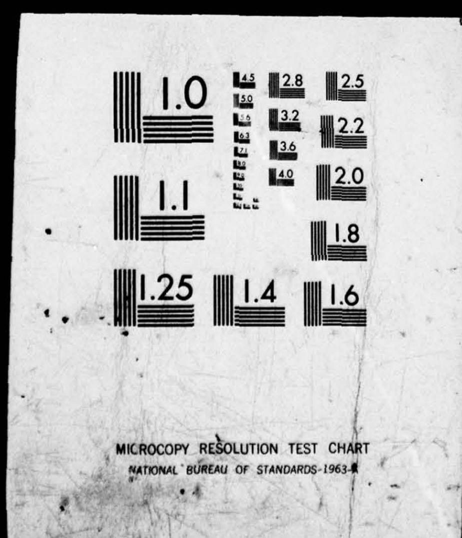
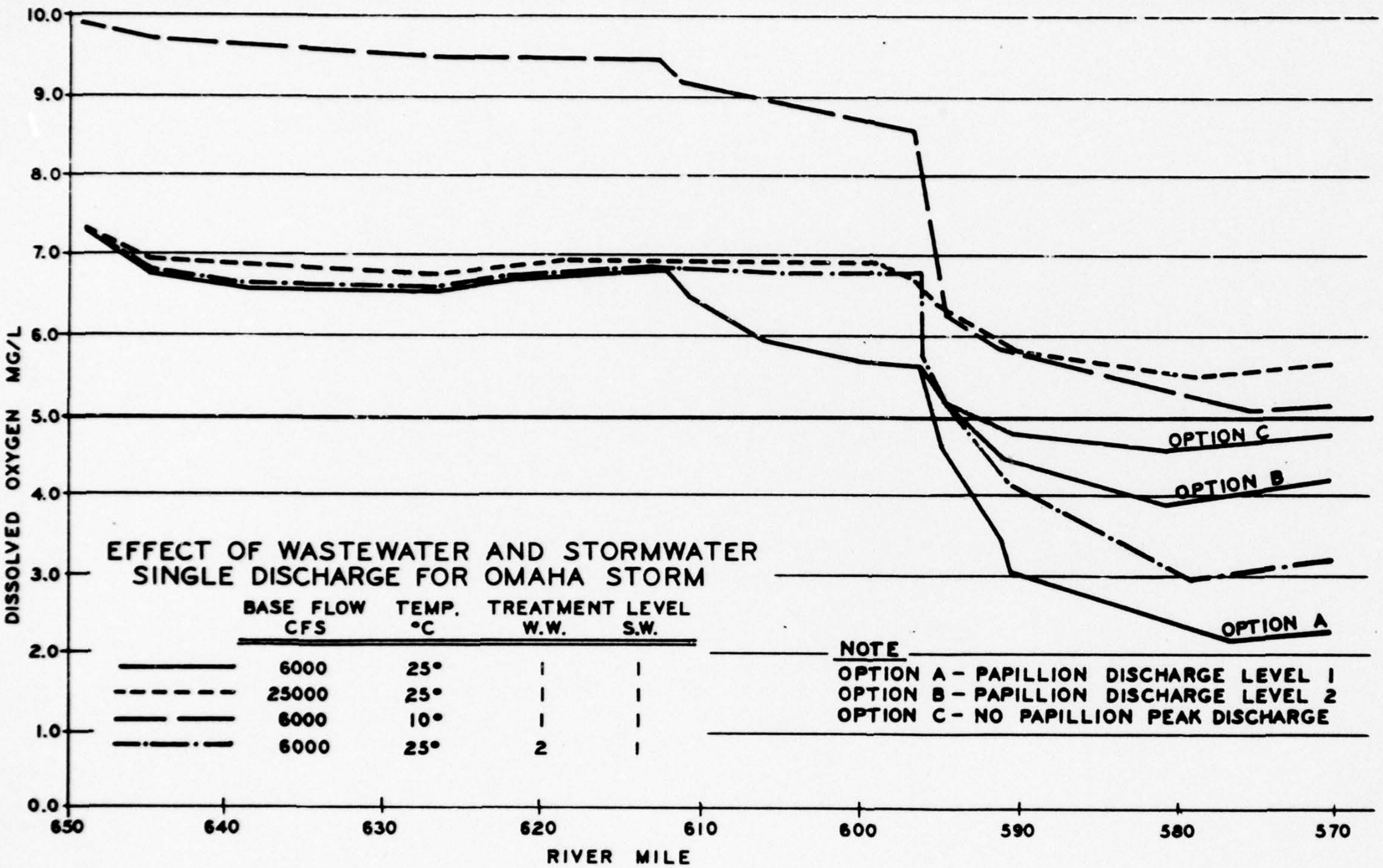


59. Level 3 treatment does not improve the Missouri River quality and does not significantly improve the water quality of Little and Big Papillion Creeks. If Plan 1 were implemented, Level 3 would not be required. It may be necessary under Plan 2 for Bennington and Elkhorn.

60. The above statements are based primarily on modeling for dissolved oxygen only. Other constituents discharged into the Missouri River (average flow 16,150 MGD) do not produce changes which result in non-compliance with water quality standards. This is not to imply that other constituents are not important. Ammonia toxicity could eventually become a problem according to some researchers who have investigated temperature, pH, un-ionized ammonia, and toxicity relationships.

61. Nebraska's water quality standards call for no more than 2.9 mg/l NH_3-N and Iowa's call for no more than 2.0 mg/l NH_3-N. Some researchers have indicated that significantly lower ammonia standards should be adopted. The 2020 discharge from the three major treatment plants in the study area would increase ammonia levels in the Missouri River to about 0.9 mg/l assuming a 6,000 c.f.s. river flow. Ammonia concentrations currently average 0.1 mg/l. Therefore, under current Nebraska and Iowa standards, there should be no ammonia violation. Further research may, however, cause revision in the States' water quality standards. If ammonia becomes critical, Level 2 treatment would be required. Ammonia toxicity and dissolved oxygen are critical in the Papillion Creek and other drainage basins. Level 2 treatment is therefore required for Bennington, Elkhorn, Gretna, and possibly other communities. Whether or not treatment beyond the secondary level



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MISSOURI STREAM MODELING

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME III ANNEX B FIGURE G-1

will be required for additional communities will be determined through the States 303(e) plans and legislation at the national level.

62. Employment. The increase in treatment levels would have a beneficial impact on the labor market of the study area. Additional jobs would be created by the increases in treatment levels, as depicted in table G-14. It is assumed that the labor requirements for Levels 2 or 3 would be the same. No figures are available for the land treatment schemes, but it is assumed that some additional jobs would be created by the land treatment operations.

63. Chemical and Energy Requirements. As the level of treatment increases, the chemical and energy requirements would also increase. This factor is an important consideration since conservation of the natural resources is becoming more important. For conventional treatment, the energy requirements increase by a factor of about 1.5 and the chemical requirements double from Level 1 to Level 2 treatment. The requirements for Level 3 were not computed, but they would be even higher. The differences in the chemical and energy requirements for the different levels of treatment are presented in tables G-15 and G-16 respectively.

64. The chemical requirements for the major land treatment options are lower than the requirements for Level 2 or 3 conventional treatment. The only increase above the Level 1 requirements is the amount required for conventional treatment at the Council Bluffs plant, which would use conventional treatment under Plan 3 Option. The increase in cost shown in table G-2 is for Level 2 treatment at Council Bluffs. Therefore, the actual cost for Level 3 treatment under Plan 3 Option should be slightly higher.

Table G-15
Chemical Requirements For Wastewater Treatment
(1995 Daily Average in pounds/day)

Chemical	Level 1 1/	Level 2 1/	Land Treatment Option 2/
Alum (as Al^{+3})	0	8,339	981
Lime (as $Ca(OH)_2$)	0	26,410	3,476
Sodium Carbonate	0	1,494	0
Polymer	0	562	68
Lime (as CaO)	25,643	32,293	26,243
Ferric Chloride	12,008	8,840	11,492
Chlorine	9,020	6,758	8,565

1/ Plan 1, Growth Concept A

2/ Council Bluffs plant provides Level 2 treatment, Growth Concept A

Table G-16
Energy Requirements for Wastewater Treatment
(1995 Megawhr/day)

Plan	Level	Energy Required
1	1	222
1	2	315
3 Option 1	2	843
3 Option 3	2	1,244

65. Energy requirements increase significantly for the land treatment plans as illustrated in table G-16. The increase is not noticeable under Plan 3 since the minor urban land treatment areas are close to the treatment plants. Under Plan 3 Option, the land treatment areas are from 35 to 100 miles away from the treatment plants. Pumping requirements are very high to pump this distance, which also involves an elevation increase of 150 to 600 feet above the treatment plants.

LAND TREATMENT EVALUATION

66. Land treatment of wastewater provides treatment equivalent to Level 3 treatment. Since Level 1, or secondary treatment is required prior to land irrigation, land treatment is not necessary if only Level 1 treatment is required. The land treatment options could perhaps pay for the additional expense above Level 1 treatment costs, making this form of treatment viable even if only Level 1 treatment were required. The market value of water, nutrients, and crops would have to increase above current levels before this could occur.

67. Land irrigation appears to be the most cost-effective method of achieving Levels 2 and 3 treatment. Not only is the cost of land irrigation equal to or less than conventional treatment, but also benefits are available in the irrigation water and recycled nutrients.

68. In the case of the Blue River Valley, irrigation water is needed urgently since the ground-water level is declining due to present irrigation withdrawals. The recycled water from Omaha would

take the place of present withdrawals and even recharge the aquifers. This demand for the wastewater makes the use of the land treatment system even more viable.

69. The application rate recommended by the wastewater management consultants was 33 inches per acre per year. This figure was determined for the consultant by agricultural engineers from the University of Nebraska, Lincoln. Table G-17 presents pertinent weather data and the monthly wastewater application rates for corn, the lowest irrigation water using crop grown in the land treatment areas. The recommendation for corn was 30 inches per year and 37 inches per year for grasses. An average application rate of 33 inches per year was recommended.

70. A rate of 15 inches per acre per year appears to be more reasonable. This lower rate is approximately equal to the amount presently used for irrigation in the land treatment areas. The Blue River Association of Ground Water Conservation, which serves one of the major land treatment areas, is presently allocating 15 inches of irrigation water per acre per year in order to preserve the decreasing water supply in the area. The Nebraska Soil and Water Conservation Commission State Water Plan (June 1969) estimated that from 12 to 13 inches of irrigation water were required for crop production in the land treatment areas. Several potential adverse impacts are also reduced at the lower application rate, such as erosion and ground water contamination.

71. Before any large scale operation is started, a small scale, demonstration project should be undertaken to determine the effect of land treatment under the conditions that occur in the Omaha area.

Table G-17
Land Irrigation Data

Month	Temperature[1/] (F°) Mean	Temperature[1/] (F°) Range	Precipitation[1/] (inches) Mean	Precipitation[1/] (inches) Range	Pan Evaporation[2/] (inches)	Application Rate[3/] For Wastewater (inches)
January	22.3	11.2 - 33.3	.52	0. - 1.65	-	0
February	27.7	16.7 - 38.7	.76	.07 - 3.39	-	0
March	35.5	24.3 - 46.7	1.18	.01 - 5.57	-	2
April	49.9	37.6 - 62.2	2.47	.35 - 6.25	-	0
May	60.7	48.7 - 72.7	3.78	.43 - 7.65	8.89	4
June	70.7	58.9 - 82.4	4.40	.71 -13.96	9.55	6
July	76.3	63.9 - 88.7	3.00	.63 - 9.60	10.41	6
August	75.0	62.5 - 87.4	2.54	.50 - 6.40	9.04	6
September	64.4	51.6 - 77.2	2.51	.12 - 9.00	5.68	3
October	53.7	40.1 - 67.3	1.08	0. - 4.42	-	0
November	38.2	26.0 - 50.3	0.61	0. - 2.40	-	2
December	27.0	16.2 - 37.8	0.56	.02 - 2.17	-	0

1/ Local Climatological Data - 1974, Grand Island, Nebraska.

2/ Climatic Summary of the United States - Supplement for 1951 through 1960, U. S. Weather Bureau, Grand Island, Nebraska data. (Dash means no record)

3/ Values shown are for corn only.

Such a project has been proposed by the Corps' consultants, Havens and Emerson, at a Boys Town site and a discussion of the project is included in Annex H of the Supporting Technical Reports Appendix. Favorable response and support has also been received for demonstration projects in the Blue River basin. Following is a discussion of the major factors which must be investigated in the demonstration projects.

72. The removal of nutrients from wastewater has been extensively investigated in the past. Removals of 80 to 99 percent can be expected for phosphorous and nitrogen. At the land application rate of 15 inches per year, removals should be near the top of this range. As the application rate increases, the removal efficiencies will decrease. Of particular importance will be the removal of nitrogen. Nitrate-nitrogen, NO_3, is the form that ammonia nitrogen is converted to during oxidation processes. This form of nitrogen is also easily leached through the soil and can contaminate the ground water. Since this condition could result in a violation of the Safe Drinking Water Act Standards and has detrimental health effects on infants, the amount of leaching that could occur should be investigated.

73. The buildup of dissolved solids in the soil should also be investigated. In an EPA technical bulletin entitled "Evaluation of Land Application Systems" (March 1975), levels of total dissolved solids (TDS) were presented which would be detrimental to the yields of various crops. A total dissolved solids concentration on 1,408 mg/l can be tolerated by corn with no effect on yield and 1,600 mg/l can be tolerated by soybeans. Two other crops grown in the land treatment regions are sorghum and wheat. They also have high

TDS tolerances, 1,728 mg/l for sorghum and 1,984 mg/l for wheat, with no loss in productivity. If rotation of crops were to be practiced with clover or alfalfa included in the rotation, levels of 576 mg/l and 832 mg/l can be tolerated by clover and alfalfa, respectively, with no loss in productivity. Minor and non-urban TDS levels are about 500 mg/l and the Papillion and Missouri River plants combined flow contain about 900 mg TDS/l. A buildup of TDS in the soil could also lower the yield of crops harvested.

74. The application of wastewater containing heavy metals could have detrimental effects on the soil and crops. The same EPA land treatment report presents some recommended maximum levels of trace metals for irrigation waters. Based on preliminary data, the levels of several of the trace elements at the Missouri River plant are too high for irrigation. The city of Omaha has been doing some research on the source of heavy metals in order to reduce the levels being recorded in the effluent at the Missouri River plant. Those interested in implementing land treatment should check with the city of Omaha Public Works Department on the present status of heavy metal monitoring and research. Heavy metals generally can be removed by industrial pre-treatment.

75. Even though the effluent is chlorinated, some of the coliforms and viruses may not be killed. Exposure to the viruses could become a problem if proper precautions are not exercised. The use of low-misting irrigators and buffer areas would be required to minimize any chance of contamination. No unusual contamination effects have been reported in existing systems.

76. Clogging of the soil with suspended solids and microbiological growth could be a problem. Alternate periods of wet and dry conditions as well as tillage should alleviate any problems. The lower application rate of 15 inches per acre per year would also reduce any potential clogging problems.

77. There are several existing land treatment projects in the United States. The most notable one is the project at Muskegon, Michigan. This system is working up to expectations and appears to have solved several wastewater management problems.

78. Three reports that are good sources for those interested in learning more about land treatment and its effects are:

- "Evaluation of Land Application Systems", U.S. Environmental Protection Agency, EPA-430/9-75-003, March 1975.

- "Assessment of the Effectiveness and Effects of Land Disposal Methodologies of Wastewater Management", Department of the Army, Corps of Engineers, Wastewater Management Report 72-1, January 1972.

- "Factors Involved in Land Application of Agricultural and Municipal Wastes", Agricultural Research Service, U.S. Department of Agriculture, July 1974.

79. Under Plan 3 Option, the Papillion Creek and Missouri River plants would convey their effluents to the land treatment areas for 270 days out of the year. During the winter months, the plan calls for discharging the Level 1 effluent to the Missouri River.

Based on a limited amount of analysis of Level 1 discharge to the Missouri River, this plan appears to be acceptable. Dissolved oxygen modeling of the Missouri River indicated that, at low flow and low temperature, the DO standard of 5.0 mg/l would be maintained as long as all wastewater, sanitary and storm runoff, received Level 1 treatment (see figure G-1). Ammonia and phosphorous levels would also be affected by Level 1 discharges. There is currently no phosphorous standard and the nitrogen standard is met by the predicted 2020 flows (see table G-2). Based on these three criteria, winter discharge of the major urban effluents, from all three plants with Level 1 treatment, is acceptable.

80. If future analysis of Level 1 discharge to the Missouri River indicates that a higher level of treatment is required, the option of storing the winter discharges should be considered. An additional 3,900 acres would be required for storing the winter flows. The present worth cost to store the winter flows is estimated to be about $18 million. The cost to go to Level 2 treatment for the Papillion Creek and the Missouri River plants is estimated to be an additional $65.6 to $67.9 million, depending on the growth concept and wastewater management plan. This analysis indicates that storage of winter effluents from the Papillion Creek and Missouri River plants should be considered instead of going to Level 2 treatment for these two major urban plants.

Urban Stormwater Treatment

81. This section presents the evaluation of the alternatives for the abatement of combined sewer overflows in the Omaha-Missouri River sewerage system, the Little Papillion Creek combined sewer area, and the Indian Creek combined sewer area, as well as storm runoff in the other urban areas of the study area. Further studies will be required to determine which level of treatment is necessary. These studies are outlined in Annex D of the Supporting Technical Reports Appendix. As a minimum, Level 1 stormwater treatment would be required.

OMAHA-MISSOURI RIVER COMBINED SEWER OVERFLOWS

82. Five final plans for evaluation were presented in Section F as alternative solutions for the combined sewer overflows in the Omaha-Missouri River sewerage system. For the purpose of this evaluation, two additional alternatives will be evaluated. These two alternatives are do-nothing and rehabilitation of the present system. The do-nothing alternative is not acceptable from a pollution control standpoint, but was included for comparison purposes. The rehabilitation-of-present-system alternative was included since implementation of this alternative reduces the total pollutant load considerably by insuring that all dry-weather flow receives treatment. This alternative would not be entirely acceptable as a pollution control alternative since the overflows would not be treated. All seven of the alternatives are described and their impacts sum-summarized in table G-18.

Table G-18

Summary Comparison of Alternative Omaha-Missouri River Combined

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
A. Plan Description	Existing system.	Automated gate control at the overflow locations. Dual pumping and grit removal facilities.	Buried storage at overflow points with rough screening, sedimentation, and chlorination.	Diked storage levee with se treatment.
B. Significant Impacts	Continued pollution of the Missouri River with raw sewage, both dry-weather flow and wet-weather overflows. State water quality standards are violated.	Eliminates pollution by dry-weather bypasses due to system breakdowns and post-storm waiting periods to reset overflow gates. State water quality standards are violated.	Removes approximately 40 percent of the BOD and 70 percent of the suspended solids from the most concentrated portion of the overflows. Requires little surface area since the reservoirs will be buried. Should have little aesthetic impact.	Removes about percent of th and 90 percen the suspended from all stor from storms u 1-year storm. water quality dards maintai Potential for problems if a fail. Close imity to popu Uses consider riverfront la
C. Plan Evaluation				
1. Contributions to planning objectives	None	All dry-weather flows are sent to the sewage treatment plant.	Partially meets the goal of meeting water quality standards. All combined sewer flows are tested up to the 1-year storm.	Water quality dards met. A bined sewer f are treated u the 1-year st
2. Relationship to the four national accounts				
a. NED				
(1) Beneficial impacts ($ million)	0	0.3	11.5	2.4
(2) Adverse impacts ($ million)	0	5.5	230.6	98.9
b. EQ				
(1) Aesthetics	Undesirable	Slight improvement	Moderate improvement	Greatly impr
(2) Water quality standards met	No	No	Close	Yes
(3) Land requirements	0	Minimal	Minimal-buried storage.	214 acre

2

Table G-18
Comparison of Alternative Omaha-Missouri River Combined Sewer Plans

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
utomated gate con- rol at the overflow ocations. Dual umping and grit emoval facilities.	Buried storage at overflow points with rough screening, sedimentation, and chlorination.	Diked storage along levee with secondary treatment.	Deep tunnel north to ground-level storage with secondary treatment.	Excavated storage north-deep tunnel to ground level storage south with secondary treatment.	Deep tunnel to mined storage with secondary treatment.
liminates pollu- ion by dry- eather bypasses ue to system reakdowns and ost-storm waiting eriods to reset verflow gates. tate water quality tandards are iolated.	Removes approximately 40 percent of the BOD and 70 percent of the suspended solids from the most concentrated portion of the overflows. Requires little surface area since the reservoirs will be buried. Should have little aesthetic impact.	Removes about 65 percent of the BOD and 90 percent of the suspended solids from all stormwater from storms up to the 1-year storm. State water quality standards maintained. Potential for odor problems if aerators fail. Close proximity to population. Uses considerable riverfront land.	Same removals as Alt. 2. State water quality standards maintained. Potential of odors if mechanical equipment fails; proximity to low density populations. Uses Iowa land to store Omaha wastewater.	Same as Alt. 4A.	Same removals as Alt. 2. State water quality standards maintained. All facilities below ground; no odor potential.
ll dry-weather lows are sent to he sewage treatment lant.	Partially meets the goal of meeting water quality standards. All combined sewer flows are tested up to the 1-year storm.	Water quality standards met. All combined sewer flows are treated up to the 1-year storm.	Same as Alt. 2.	Same as Alt. 2.	Same as Alt. 2.
0.3	11.5	2.4	12.7	7.6	31.0
5.5	230.6	98.9	149.7	133.5	189.6
light improvement	Moderate improvement	Greatly improved	Greatly improved	Greatly improved	Greatly improved
No	Close	Yes	Yes	Yes	Yes
Minimal	Minimal-buried storage.	214 acres	120 acres	142 acres	Minimal

Table G-18
(Cont'd)
Summary Comparison of Alternative Omaha-Missouri River Combined

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt.
c. SWB				
(1) Cost per customer per month ($)	0	.02	1.04	1.48
d. RD				
(1) Net benefits ($ million)				
(a) Local	0	-0.4	- 23.1	-55.2
(b) State	0	-0.7	- 28.0	- 5.9
(c) Federal	0	-4.1	-168.0	-35.4
(d) Total	0	-5.2	-219.0	-96.5
(2) Full-time employment opportunities	0	0	+ 5	+20
3. Plan response to associated evaluation criteria				
a. Acceptability by pollution control authorities	No	Presently - yes Near future - no	Probably	Yes
b. Likelihood of public acceptance	Fair	Good	Good	Poor
c. Reliability				
(1) Wet-weather	Low	Low	Moderate	Moderate
(2) Dry-weather	Low	High	High	High
d. Disruptive effects	Low	Low	Low	Moderate
e. Site availability	—	Fair	Poor	Fair
f. Uncertainties	—	—	—	—

2

Table G-18
(Cont'd)
Comparison of Alternative Omaha-Missouri River Combined Sewer Plans

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
.02	1.04	1.48	1.78	1.72	2.12
-0.4	- 23.1	-55.2	- 52.5	- 55.7	- 47.8
-0.7	- 28.0	- 5.9	- 12.1	- 10.0	- 15.8
-4.1	-168.0	-35.4	- 72.4	- 60.2	- 95.0
-5.2	-219.0	-96.5	-137.0	-125.9	-158.6
0	+ 5	+20	+ 23	+ 23	+ 19
Presently - yes Near future - no	Probably	Yes	Yes	Yes	Yes
Good	Good	Poor	Fair - opposition in Iowa.	Fair - opposition in Iowa.	Good
Low	Moderate	Moderate	High	High	High
High	High	High	High	High	High
Low	Low	Moderate	Low	Moderate	Low
Fair	Poor	Fair	Good	Good	Good
—	—	—	Rock quality for deep tunneling. Pressure head to reach north site questionable.	Rock quality for deep tunneling.	Rock quality for deep tunneling and underground storage.

Table G-18
(Cont'd)
Summary Comparison of Alternative Omaha-Missouri River Combined S

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
D. Implementation Responsibility				
1. Procedure	—	City of Omaha requests funding, builds, and operates.	City of Omaha requests funding, builds, and operates.	Same as Alt. 1
2. Funding				
a. Capital costs	—	Omaha - 12.5% State - 12.5% Federal - 75%	Omaha - 12.5% State - 12.5% Federal - 75%	Same as Alt.1.
b. O&M	—	Omaha - 100%	Omaha - 100%	Omaha - 10
3. Institutional problems	—	None	None	Agreements wit Carter Lake an for reservoir l tions probable Omaha.

2

Table G-18
(Cont'd)
Comparison of Alternative Omaha-Missouri River Combined Sewer Plans

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
City of Omaha requests funding, builds, and operates.	City of Omaha requests funding, builds, and operates.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
Omaha - 12.5% State - 12.5% Federal - 75%	Omaha - 12.5% State - 12.5% Federal - 75%	Same as Alt.1.	Same as Alt.1.	Same as Alt.1.	Same as Alt.1.
Omaha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%
None	None	Agreements with Carter Lake and Iowa for reservoir locations probable by Omaha.	Agreement with Iowa for reservoir location probable by Omaha.	Agreements with Carter Lake and Iowa for reservoir locations probable by Omaha.	None

IMPACT ASSESSMENT AND EVALUATION OF THE ALTERNATIVE PLANS

83. Beneficial and adverse impacts of the seven final alternative plans are evaluated and displayed in four accounts on table G-19. The four accounts are national economic development (NED), environmental quality (EQ), social well-being (SWB), and regional development (RD).

Table G-19
System of Accounts - Missouri River Combined Sewer Ove

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	
I. National Economic Development					
A. Beneficial Impacts ($ million)					
1. Value of increased output of goods and services.	3, 5, 7, 10	0	0	0	
2. Value of unemployed labor utilized.	3, 5, 7, 9	0	0.3	11.5	
3. Total		0	0.3	11.5	
B. Adverse Impacts Plan Costs ($ million)	3, 5, 7, 9				
1. Capital		0	5.5	224.0	
2. O&M		0	—	6.6	
3. Total		0	5.5	230.6	
C. Net NED Impacts ($ million)		0	- 5.2	- 219.1	
II. Environmental Quality					
A. Aesthetics	2, 5, 8, 9	Localized floating solids and odors. Fishery quality unacceptable.	Floating solids and odors can occur after heavy rains. Fishery quality unacceptable.	Solids and odors eliminated. Minor deterioration of water quality. Required facilities will have a minimal aesthetic impact.	Impro theti sites verse Possi tial malfu proxi lated
B. Water Quality	2, 5, 8, 9				
1. Surface water					
a. Residual pollutant load to the river (tons/yr)					
(1) BOD		7,400	2,000	1,200	
(2) SS		7,700	4,000	1,200	

1/ Footnotes indexed at the end of table G-22

2

Table G-19
n of Accounts - Missouri River Combined Sewer Overflows

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
0	0	0	7.9	3.6	25.0
0.3	11.5	2.4	4.8	4.0	6.0
0.3	11.5	2.4	12.7	7.6	31.0
5.5	224.0	47.2	96.5	80.2	126.6
—	6.6	51.7	53.2	53.3	63.0
5.5	230.6	98.9	149.7	133.5	189.6
- 5.2	- 219.1	- 96.5	- 137.0	- 125.9	- 158.6
Floating solids and odors can occur after heavy rains. Fishery quality unacceptable.	Solids and odors eliminated. Minor deterioration of water quality. Required facilities will have a minimal aesthetic impact.	Improved river aesthetics. Storage sites will have adverse visual impacts. Possible odor potential if aerators malfunction. High proximity to populated areas.	Improved river aesthetics. Minimal visual impacts. Possible odors if aerators fail. Low proximity to population.	Same as 4A	Improved river aesthetics. No visual impact or odor potential.
2,000	1,200	705	705	705	705
4,000	1,200	885	885	885	885

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Table G-19
(Cont'd)
System of Accounts - Missouri River Combined Sewer Ove

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	
b. Meets state water quality standards		No	No	Close	
2. Ground water		No effect	No effect	No effect	No ef per a engin ples.
C. Land Requirements (acres)	1, 5, 7, 9	0	Minimal	Minimal - all buried storage.	
D. Air Quality	3, 4, 8, 10	Odors at outfall locations.	No effect	No effect	Possi odors fail.
E. Wildlife Habitat	2, 5, 8, 9	No effect	No effect	No effect	Would bank for f wildl
III. Social Well-Being					
A. Average Monthly Total Costs Per Customer	2, 5, 7, 9	0	$.02	$1.04	
B. Average Monthly Energy Cost Per Customer	2, 5, 7, 9	0	—	—	
C. Water-Related Recreation	2, 5, 8, 9			See text - par	
IV. Regional Development					
A. Economic Development					
1. Benefits ($ million)					
(a) Local	1, 5, 7, 9	0	0.3	11.5	
(b) State	1, 5, 7, 9	0	—	—	
(c) Federal	1, 5, 7,.9	0	—	—	
(d) Total		0	0.3	11.5	

1/ Footnotes indexed at the end of table G-22

2

Table G-19
(Cont'd)
ystem of Accounts - Missouri River Combined Sewer Overflows

	Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
	No	Close	Yes	Yes	Yes	Yes
	No effect	No effect	No effect with proper application of engineering principles.	Same as Alt. 2 plus proper tunneling investigation and location required.	Same as Alt. 4A	Same as Alt. 4A
	Minimal	Minimal - all buried storage.	214	120	142	Minimal
1	No effect	No effect	Possibility of odors if aerators fail.	Possibility of odors if aerators fail.	Possibility of odors if aerators fail.	No effect
	No effect	No effect	Would remove near-bank habitat areas for forest and wildlife areas.	Agricultural land which supports some small game would be used for storage sites; buffer areas would increase small species habitat.	Same as Alt. 4A	No effect
	$.02	$1.04	$1.48	$1.78	$1.72	$2.12
	—	—	$.67	$.79	$.76	$1.11
		See text - paragraph				
	0.3	11.5	2.4	12.7	7.6	31.0
	—	—	—	—	—	—
	—	—	—	—	—	—
	0.3	11.5	2.4	12.7	7.6	31.0

Table G-19
(Cont'd)
System of Accounts - Missouri River Combined Sewer Overflows

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
2. Costs ($ million)					
(a) Local	3, 5, 7, 9	0	0.7	34.6	57.6
(b) State	1, 5, 7, 9	0	0.7	28.0	5.9
(c) Federal	1, 5, 7, 9	0	4.1	168.0	35.4
(d) Total		0	5.5	230.6	98.9
3. Net benefits ($ million)					
(a) Local	3, 5, 7, 9	0	- 0.4	- 23.1	- 55.2
(b) State	1, 5, 7, 9	0	- 0.7	- 28.0	- 5.9
(c) Federal	1, 5, 7, 9	0	- 4.1	- 168.0	- 35.4
(d) Total		0	- 5.2	- 219.1	- 96.5
B. Local Employment Change	1, 5, 8, 9	0	0	Additional 5 full-time jobs.	Additional 20 time jobs.
C. Population Distribution	3, 4, 8, 10	Adverse aesthetic conditions caused by raw and combined sewage discharge may discourage such riverfront projects as Marina City.	Similar to do-nothing except less severe.	Improved river conditions may aid Riverfront projects.	Aerated lagoo conflict with front develop light industr areas south o Carter Lake b improved rive ity would all substantial R area of Carte and Eppley Ai
D. Affect On Agricultural Development	1, 5, 8, 9	No effect	No effect	No effect	No effe

1/ Footnotes indexed at the end of table G-22

2

Table G-19
(Cont'd)
tem of Accounts – Missouri River Combined Sewer Overflows

	Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
	0.7	34.6	57.6	65.2	63.3	78.8
	0.7	28.0	5.9	12.1	10.0	15.8
	4.1	168.0	35.4	72.4	60.2	95.0
	5.5	230.6	98.9	149.7	133.5	189.6
	- 0.4	- 23.1	- 55.2	- 52.5	- 55.7	- 47.8
	- 0.7	- 28.0	- 5.9	- 12.1	- 10.0	- 15.8
	- 4.1	- 168.0	- 35.4	- 72.4	- 60.2	- 95.0
	- 5.2	- 219.1	- 96.5	- 137.0	- 125.9	- 158.6
	0	Additional 5 full-time jobs.	Additional 20 full-time jobs.	Additional 23 full-time jobs.	Additional 23 full-time jobs.	Additional 19 full-time jobs.
t l ed ch ts	Similar to do-nothing except less severe.	Improved river conditions may aid Riverfront projects.	Aerated lagoons may conflict with Riverfront development's light industrial areas south of Carter Lake but improved river quality would allow for substantial R.D. in area of Carter Lake and Eppley Airport.	Open storage north of C.B. may conflict with R.D's park preservation and recreation area. Improved river quality would allow for substantial R.D. in the area of Carter Lake and Eppley Airport.	Open storage south of C.B. may conflict with R.D's new town and parks and rec. areas. Improved river quality would allow for substantial R.D. in the area of Carter Lake and Eppley Airport.	Improved river quality will aid R.D. projects. Increased capacity will allow substantial industrial development in Carter Lake and Eppley Airport. Implementation would not adversely affect any R.D. project.
	No effect	No effect	No effect	Loss of 120A	Loss of 75A	No effect

84. <u>National Economic Development</u>. The national economic development account includes a measurement in output of goods and services on a national basis. This account includes both beneficial and adverse impacts and concludes with a computation of the net NED benefits.

85. The beneficial impacts are hard to quantify in terms of dollars. For example, the reduction in pollution in the Missouri River will improve its aesthetic and recreational value, but there is no way of converting this benefit into an economic value. Due to this factor, the net benefits are negative and the benefit/cost ratios were not computed for the combined sewer overflow plans.

86. Only two benefits could be easily quantified for use in the NED account. The first was that of saleable rock from tunnel excavation under Alternatives 4A, 4B, and 5A. Alternative 5A also had a large quantity of rock excavated from the underground storage chambers which could be crushed and sold as gravel. A value of $3.50 per ton was used to compute the benefits.

87. The second beneficial impact was the value of unemployed labor that would be used to construct each alternative. Labor costs make up approximately 50 percent of the capital costs. It is assumed that 10 percent of the labor will come from the unemployed ranks, therefore 5 percent of the total capital cost is considered as a beneficial impact.

88. The adverse impacts consist of the present worth costs for implementing the alternative plans.

89. The net NED impacts are the differences between the beneficial and adverse impacts. With the exception of the do-nothing alternative, all of the alternatives have negative net NED impacts. The net impacts range from zero for do-nothing up to minus $219.1 million for Alternative 1. The equivalent-treatment plans, Alternatives 2, 4A, 4B, and 5A, range from minus $96.5 million to minus $158.6 million. Alternative 2 is the NED plan since it has the highest net NED benefit and also meets the planning objectives of the wastewater management study.

90. <u>Environmental Quality</u>. The six plans that provide for some form of treatment would result in improvements to Missouri River quality. They not only would reduce the BOD and suspended solids load, but also would reduce the loadings of fecal coliform, nutrients, toxic substances, dissolved solids, metals, and chemicals that presently are being discharged to the Missouri River. Alternatives 2, 4A, 4B, and 5A, would provide enough treatment for the river water quality to meet state standards.

91. Ground water contamination should not be a problem as long as proper precautions are taken prior to and during construction. The surface storage alternatives, 2, 4A, and 4B, would require reservoirs with clay-lined bottoms for protection against seepage from the reservoirs. The deep-tunneling alternatives, 4A, 4B, and 5A, and the underground-storage alternative, 5A, would require the location of the facilities in deep bedrock formations. Proper preconstruction investigations, such as exploratory drilling, should be made in order to determine the adequacy of the bedrock. Contamination of the deep, ground water aquifers could occur if necessary precautions are not undertaken. An alternative of shallow,

lined tunnels should be investigated. Lining of deep tunnels and storage chambers should also be investigated to prevent any potential ground water contamination possibilities.

92. The plans vary in their effect on land quality. System rehabilitation would require several small sites for construction of the dual facilities. Alternative 1 would require land for storage near the sewer outfalls, but the structures would be buried thereby minimizing the need for surface land. The top of the structures could be used for recreational purposes such as tennis courts. Alternative 5A has underground storage facilities and would require minimal land. Alternatives 2, 4A, and 4B would have adverse impacts on the environmental quality of the land. From 120 to 214 acres of surface area would be required for the storage facilities. All of the six alternatives would be disruptive to land quality during the construction phase.

93. Some of the alternatives could affect the air quality in the form of odors. The do-nothing alternative creates odor problems at the outfall locations whenever dry-weather bypasses occur. The alternatives with open storage, Alternatives 2, 4A, and 4B, could also cause odor problems if the aerators were to fail. From May through December the prevailing winds are from the south-southeast. These winds could carry odors from storage locations along the river and south of Council Bluffs into populated areas of Omaha. Since the storage lagoons would be storing wastewater during the May to December period, the plans calling for storage along the river or south of Council Bluffs should incorporate special features to minimize any potential odor problems. Alternative 4A would be the best open-storage plan from an air quality standpoint. Alternative 5A is

the best overall plan from an air quality standpoint since it calls for underground storage.

94. Alternatives 2, 4A, and 4B would have negligible effects on wildlife habitats at the storage locations. Each site is presently in agricultural use. Vegatated buffer areas around the lagoons would be beneficial to numerous wildlife species, particularly the smaller birds and mammals.

95. The EQ plan is Alternative 5A since it has the best overall environmental benefit.

96. Social Well-Being. The social well-being account includes measurements of the plan characteristics that may affect people directly. These impacts could affect an individual financially or in the way he lives.

97. The beneficial impacts are best expressed as the change in water-related recreation that could occur. With improved Missouri River water quality, water-related recreation should improve. As with the wastewater treatment plans, the improved recreation would not be body-contact recreation due to the high flow of the river. Alternatives 2, 4A, 4B, and 5A would improve the river quality the most.

98. The cost to an individual customer is the most appropriate way to express the adverse social well-being impacts. The cost of the alternative to the city of Omaha was determined and this was then converted to a per customer per month cost for those customers served by the Omaha sewerage systems. The alternatives range in cost from $.02 per customer per month to $2.12 per customer per month.

99. Average monthly energy costs per month per customer are also shown in table G-19. These are shown for two reasons; first, to indicate that energy costs make up a significant portion of the costs and second, energy conservation should be considered when selecting a plan for implementation. Alternative 2 is the most energy-conserving plan of Alternatives 2, 4A, 4B, and 5A. There is from 10 to 20 percent difference in energy use between Alternative 2 and Alternatives 4A and 4B, the next two most energy-conserving alternatives.

100. Regional Development. The regional development account includes a measurement of the distribution of beneficial and adverse impacts among various geographic subdivisions. In the case of the Omaha-Missouri combined sewer overflow problem, four areas will be affected, the city of Omaha (local), Pottawattamie County, the State of Nebraska, and the Federal government.

101. The cost of the selected alternative plan would be shared by all four agencies just mentioned. Of the capital costs, the city of Omaha would pay 12.5 percent, the State of Nebraska would pay 12.5 percent, and the Federal government would pay the remaining 75 percent. All of the operation and maintenance costs would be paid by the city of Omaha.

102. The important item to analyze is the net benefits portion of the account. It depicts the net cost that would be incurred by each governmental level. It is interesting to note that the capital and O&M distribution of costs has a significant effect on the costs for the various governments. The most expensive alternatives are among the lowest cost alternatives at the local level. The four alternatives, 2, 4A, 4B, and 5A, are relatively close to costing

the same from a local net benefit standpoint, ranging in local cost from $47.8 million to $55.7 million. As the local costs go down, the State and Federal costs go up, representing a shift from O&M intensive alternatives to capital intensive alternatives.

103. The population distribution in Omaha could be affected by the alternative selected. Omaha is currently expanding westward and the riverfront area is slowly being abandoned. Improved river conditions could slow down or even reverse this current trend.

104. Area agricultural development would be negligibly affected by the small amounts of land that would be removed from production for storage basin location. Pottawattamie County, Iowa farmland would be used in Alternatives 4A and 4B.

OTHER CONSIDERATIONS

105. Two other considerations must be evaluated before selecting one of the seven alternatives. These two criteria are acceptability and equity.

106. Acceptability. As mentioned earlier, do-nothing is unacceptable by pollution control authorities and legislators. Rehabilitation is critical since it insures that all dry-weather flows would receive treatment. The combined sewer overflows are not treated through rehabilitation, therefore, one of the other five alternatives or some combination must be selected. The other five alternatives are acceptable from a pollution control standpoint, with Alternative 1 being only marginally acceptable, subject to more investigation.

107. The likelihood of public acceptance is also an important criteria. The public's voice has become stronger in recent years and is carrying more strength in arriving at a final decision. Of the five alternatives, 5A is most acceptable to the public. Open storage is opposed, particularly in Council Bluffs.

108. At public meetings, another alternative, sewer separation, was discussed. Although the present worth costs of separation would amount to $539 million, separation received as many first-place votes as did Alternative 5A.

109. Although Alternative 2 is the NED alternative, it would encounter the most opposition. Recent efforts to locate a well-managed "bale-fill" disposal site in the same area as one of the storage reservoirs was violently opposed by the public. Alternatives 4A and 4B have received opposition from some officials in Council Bluffs. Council Bluffs has been plagued with odor problems mainly from a meat-packing plant and residents are very odor conscious. Adequate safeguards against odors in the two reservoir locations could be provided. Adjacent land uses are primarily agricultural and industrial.

110. It is likely that the final alternative could be a combination of Alternatives 4B and 5A. Storage reservoirs located in the north portion (Alternative 4B) are located primarily in industrial areas. Buried storage in the south portion (Alternative 5A) would reduce adverse aesthetic impacts in a densely populated area. Significant quantities of Iowa land would not be required. Costs of this alternative would be more than 4B but less than 5A. In essence, this alternative is similar to 4B except in that the large Iowa

storage reservoir would be replaced by the buried storage of Alternative 5A. Annex J of the Supporting Technical Reports Appendix discusses this alternative.

PAPILLION CREEK COMBINED SEWER OVERFLOWS

111. Three alternatives for the abatement of the combined sewer overflows to Little Papillion Creek from the Benson-Westside and Saddle Creek service areas were selected for final evaluation. The alternatives were sewer separation, storage with treatment before discharge, and storage with conveyance to the Papillion Creek Sewage Treatment Plant for treatment. The evaluation is summarized in table G-20.

112. From a pollution control standpoint, the upsystem storage and conveyance alternative is the best. Most of the overflow would receive secondary treatment, with the rest receiving the equivalent to primary treatment. The effluent would then be discharged to the Missouri River. Upsystem storage and treatment provides only a slightly lower level of treatment, but the effluent would be discharged to Little Papillion Creek, which has a low assimilative capacity. The effluent would have more of an impact on Little and Big Papillion Creeks than it would in the Missouri River. State water quality standards for dissolved oxygen can be maintained, however, with this alternative. Separation would only remove the sanitary flow, but this would be an improvement since most of the fecal coliform contamination would be removed.

113. The most adverse impact of the alternatives would probably be the cost of the alternatives. Upsystem storage and treatment has a present worth cost of $55.0 million, upsystem storage and conveyance

Table G-20

Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
Plan Description		Allow the overflows to continue.	Separate the sewers into sanitary and storm sewers.	Capture overflows store them in buried concrete basins, provide the equivalent to primary treatment, and discharge to Little Papillion Creek.	Capture overflows, store them in buried concrete basins, release at a controlled rate to interceptor, provide treatment equivalent to secondary treatment to most of the overflows and primary to the high volume overflows at the Papillion Creek plant, and discharge to the Missouri River.
Significant Impacts		Pollution of Little and Big Papillion Creeks. Raw sewage flows in parks and near residential areas.	All sanitary wastewater receives treatment. Stormwater flow continues to pollute Little and Big Papillion Creeks.	Removes 40% BOD, 70% SS, all of fecal coliforms, and some of the other pollutants from Little and Big Papillion Creeks due to combined sewer overflows.	Removes all of the combined sewer flows from Little and Big Papillion Creeks up to the design storm.
Plan Evaluation					
1. Contributions to planning objectives		None	Removes sanitary flows from Little Papillion Creek.	Provides treatment of combined sewer overflows adequate to maintain D.O. levels.	Provides treatment of combined sewer overflows adequate to maintain D.O. levels.
2. Relationship to four National accounts					
a. NED ($ million)	3, 5, 7, 9				
(1) Beneficial impacts		None	7.0	2.5	4.2
(2) Adverse impacts		None	140.4	55.0	86.6
(3) Net impact		None	-132.6	-52.5	-82.4

1/ Footnotes indexed at the end of table G-22

Table G-20
(Cont'd)
Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes 1/	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat
b. EQ	2, 5, 8, 9				
(1) Beneficial impacts		None	Slight increase in species diversity of aquatic life. Reduction in disease potential due to human wastes.	Improvement in species, diversity of aquatic life. Disease potential greatly reduced.	Improvement in species, diversity of aquatic lif Disease potential greatly reduced.
(2) Adverse impacts		Low aquatic life species diversity. Disease potential high due to human fecal contamination.	Disruption of residential, park, and commercial areas during construction.	Requires land for storage (449 ac-ft) and treatment facilities. Disruption of residential, park, and commercial areas during construction.	Requires land for storage (1,273 ac-ft) and treatment facilities. Disruption of residential, park, and commercial areas during construction.
(3) Pollutant loads (tons/year)				Level 1 / Level 2	Level 1 / Level 2
(a) BOD		870	330	520 / 290	520 / 290
(b) SS		2,170	3,190	650 / 220	650 / 220
c. SWB					
(1) Beneficial impacts	2, 5, 8, 9	None	Papillion Creek and Elmwood Park would be safer for recreational activities.	Same as separation.	Same as separation.
(2) Adverse impacts Cost/month-customer	2, 5, 7, 9	None	$.50	$.24	$.36

otnotes indexed at the end of table G-22

Table G-20
(Cont'd)
Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat
d. RD ($ Million)					
(1) Local costs	3, 5, 7, 9	None	17.6	8.3	12.6
(2) State costs	1, 5, 7, 9	None	17.6	6.7	10.6
(3) Federal costs	1, 5, 7, 9	None	105.6	40.0	63.4
3. Plan response to associated evaluation criteria					
a. Acceptability		No	No-pollution still will occur due to stormwater.	Yes	Yes
b. Completeness		No	Still allows major pollution due to stormwater.	Still allows minor pollution due to low strength effluent.	Yes-removes all pollution coming from combined sewer areas.
D. Implementation Responsibility		None	City of Omaha initiates funding requests for construction. Once built, city of Omaha operates and maintains.	City of Omaha (see separation).	City of Omaha (see separation).

1/ Footnotes indexed at the end of table G-22

$86.6 million, and separation $140.4 million. These costs include the capital and O&M costs for Growth Concept A for the next 50 years. The separation cost is based on a cost of $27,000 per acre. The costs would be reduced, from a NED standpoint, by the value of unemployed labor that would be used for construction. The figures presented in table G-20 are 5 percent of the capital cost. Based on net NED benefits and compliance with the planning objectives, the NED plan is upsystem storage and treatment.

114. Environmental quality would improve with the amount of treatment provided. The order of improvement is, from least to most, separation, upsystem storage and treatment, and upsystem storage and conveyance. The level of treatment provided by upsystem storage and treatment could be improved by adding microstraining to the treatment process at an additional present worth cost of $13.2 million. The improvement in the environmental quality may not warrant such an expenditure.

115. Separation, upsystem storage and treatment, and upsystem storage and conveyance will all have considerable disruptive effects to the environment during construction. The social well-being of the people in the construction areas will also be disrupted during construction. Excavation for sewers would be required in several neighborhoods in the combined sewer area. The separation alternative will probably be most disruptive since it would involve excavation and sewer hookups at residences. The other two alternatives involve trunk sewers mainly.

116. The pollutant loadings that will be discharged to Little Papillion Creek or the Missouri River are presented in table G-20. Separation will result in the lowest BOD loading and the two

treatment alternatives will result in the lowest suspended solids loading. The suspended solids loading will increase under the separation alternative since the "first flush" will not be carried in the sewers to the treatment plant as it is in a combined sewer system.

117. Because of cost factors, it is valid to compare the environmental protection of upsystem storage and treatment using Level 2 treatment (present worth cost $65.6 million) with Level 1 treatment for the conveyance alternative (present worth cost $86.6 million). Up to the design storm, the former alternative will provide 70 percent BOD removal and 90 percent suspended solids removal. Flows in excess of the design storm could be routed through the facility at a reduced treatment rate. Under the latter alternative, storm flows in excess of the design capacity of the Papillion Creek sewage treatment plant would be routed to a stormwater treatment facility with removal rates of 40 percent BOD and 70 percent suspended solids. Flows in excess of the design storm must be by-passed directly to the Little Papillion Creek. Although table C-12 indicates approximately equivalent annual pollutant removals, the upsystem treatment alternative would produce better overall removals since the majority of rainfall occurs at less than the 1-year event. For the above reasons, the upsystem storage and treatment alternative with Level 2 treatment is the EQ plan.

118. Social well-being would be affected by a reduction in adverse aesthetic conditions under all the alternatives. The cost for the alternatives ranges from about $.24 to $.50 per month per customer.

INDIAN CREEK COMBINED SEWER OVERFLOWS

119. The three alternative solutions to the Indian Creek combined sewer overflow problem are separation of the sewers, upsystem storage and treatment before discharge, and upsystem storage and conveyance to the Mosquito Creek Sewage Treatment Plant south of Council Bluffs for treatment. These alternatives and their evaluation are summarized in table G-21.

120. All three alternatives provide different amounts of treatment, depending on the rate of flow of the stormwater. Separation provides treatment for only the sanitary portion of the presently combined flow. Upsystem treatment provides treatment of the overflows equivalent to primary treatment. A major portion of the overflows would receive treatment under the conveyance alternative, with only the high stormflows receiving primary treatment. These high flows, those in excess of the treatment plant's design capacity, release more pollution per gallon than upsystem treatment flows since there is a higher portion of sanitary waste in the conveyed stormflow.

121. The alternatives range in cost from $3.4 million for separation to $13.3 million for conveyance. Upsystem treatment has a present worth cost of $9.0 million. The only measurable beneficial NED impact is the increase use of unemployed labor. The value of this benefit was estimated to be 5 percent of the capital cost of each alternative. The NED plan is separation, based on net NED benefits and compliance with the planning objectives.

122. The environmental quality of the Indian Creek basin in the area above and below the overflow point, near 28th Avenue, would be affected. The main effect would be the removal of the health

Table G-21
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
A. Plan Description		Allow the overflows to continue.	Separate the sewers into sanitary and storm sewers.	Capture overflows, store them in a buried concrete basin, provide the equivalent to primary treatment, and discharge to Indian Creek.	Capture overflows, store them in a buried concrete basin, release at a controlled rate to the main trunk sewer to the Council Bluffs-Mosquito Creek plant for secondary treatment of most of the wastewater and the equivalent to primary treatment to th rest, and discharge to the Missouri River.
B. Significant Impacts		Pollution of Indian Creek south of 28th Avenue, primarily an open space area and cropland area.	All sanitary wastewater receives treatment. Stormwater flow continues to pollute Indian Creek at various discharge points above 28th Avenue.	Removes 40%, BOD, 70% SS, all of fecal coliforms and some of the other pollutants from Indian Creek due to combined sewer overflows.	Removes all of the combined sewer flows from Indian Creek up to the design storm.
C. Plan Evaluation					
1. Contributions to planning objectives		None	Removes sanitary flows from Indian Creek.	Provides treatment of Indian Creek combined sewer overflows.	Provides treatment of Indian Creek combined sewer overflows.
2. Relationship to four National accounts					
a. NED ($ million)	3, 5, 7, 9				
(1) Beneficial impacts		None	0.2	0.4	0.7
(2) Adverse impacts		None	3.4	9.0	13.3
(3) Net impacts		None	-3.2	-8.6	-12.6

Footnotes indexed at the end of table G-22

Table G-21
(Cont'd)
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
b. EQ	2, 5, 8, 9				
(1) Beneficial impacts		None	Indian Creek water quality improved below 28th Avenue since sanitary pollutants are removed.	Indian Creek water quality improved below 28th Avenue. More diverse species of aquatic life should exist.	Indian Creek water quality improved below 28th Avenue. More diverse species of aquatic life should exist.
(2) Adverse impacts		Health hazard to wildlife and humans due to fecal contamination.	Indian Creek water quality above 28th Avenue degraded due to stormwater. This section is primarily a concrete-*lined channel though* and there is no access to most of it. Disruption of residential, park, and commercial areas during construction	Requires land for storage (376 ac-ft) and treatment facilities.	Requires land for storage (1,275 ac-ft) and treatment facilities.
(3) Pollutant loadings (tons/year)					
(a) BOD		350	90	210	210
(b) SS		870	1,020	260	260
c. SWB					
(1) Beneficial impacts	2, 5, 8, 9	None	Indian Creek would be safer from a health standpoint.	Same as separation.	Same as separation.
(2) Adverse impacts (1995) (cost/customer -month)	2, 5, 7, 9	None	$.19	$.85	$1.06

1/ Footnotes indexed at the end of table G-22

Table G-21
(Cont'd)
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes 1/	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
d. RD ($ million)					
(1) Local costs	3, 5, 7, 9	None	.4	2.0	2.8
(2) State costs	1, 5, 7, 9	None	.4	0.4	0.7
(3) Federal costs	1, 5, 7, 9	None	2.6	6.6	9.8
3. Plan response to associated criteria					
a. Acceptability		No	Yes	Yes	Yes
b. Effectiveness		No	Not as much as the treatment alternatives but is adequate for the situation.	Yes	Yes
D. Implementation Responsibility		None	City of Council Bluffs initiates funding request for construction. It then operates and maintains the system.	City of Council Bluffs (see separation)	City of Council Bluffs (see separation)

1/ Footnotes indexed at the end of table G-22

hazard that exists due to the sanitary portions of the overflows. The channel is accessible to children and there is a high possibility that contact with the Indian Creek flow during or shortly after a storm could endanger the health of these children. The Indian Creek channel is only a few hundred feet away from a large trailer court south of the overflow point and there is also some residential development near Lake Manawa.

123. The impact of the stormwater flows is not as significant as the sanitary flows. Separation would result in the addition of several stormwater discharge points north of the present overflow point. Portions of the channel above 28th Avenue are not accessible to the public. Also, the normal flow of Indian Creek is very low so there are almost no aquatic species present. Land use south of the overflow is primarily industrial and agricultural. This would indicate that there would be little benefit to treating the stormwater portion of the overflows.

124. Separation would have disruptive effects within the combined sewer area during construction. The environmental quality and social well-being of local residents would be affected by sewer construction. Since sewer hookups could be required at most residences in the area, construction could occur in the front yards of many homes and places of business. The upsystem storage alternatives require construction that would be disruptive to the environment, but construction would be in an area away from residences and places of business.

125. Pollutant loadings for each of the alternatives is presented in table G-21. Separation would result in the lowest BOD loading to Indian Creek or the Missouri River and the two treatment

alternatives would result in the lowest suspended solids loading. Separation would result in even higher suspended solids loading than the do-nothing alternative since the "first flush" would not go to the treatment plant as it would in a combined sewer system.

126. The EQ plan is upsystem storage and treatment with Level 2 treatment for the same reasons discussed in the Little Papillion Creek combined sewer overflow section.

127. The social well-being impacts are the improvement of the health conditions for those individuals near the creek and the cost of the alternatives to the citizens of Council Bluffs. The estimated average monthly costs (1995) would range from $.19 to $1.06 per month per customer.

128. The regional development impacts are also presented in table G-21. The costs of the alternatives would be split among the city of Council Bluffs, the State of Iowa, and the Federal government, with the capital costs split 20, 5, and 75 percent, respectively. The O&M costs, very low in general, would be incurred by the city of Council Bluffs.

SEPARATED STORMWATER RUNOFF

STRUCTURAL ALTERNATIVES

129. There is one final structural, separate-stormwater treatment alternative to evaluate; upsystem storage and treatment before discharge to the receiving stream. The plan description and evaluation are summarized in table G-22. The impacts for a do-nothing alternative are also given to compare with the treatment alternative.

Table G-22
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes[1/]	Do-Nothing	Upstream Storage and Treatment
Plan Description		Continue to allow the stormwater to discharge into area streams without treatment.	Intercept the stormwater at the discharge points, store it in concrete or earthen basins, release the flows at a controlled rate for the equivalent to primary treatment at facilities adjacent to the basins, and discharge to the stream. (This applies to separate stormwater systems only.) (1-yr. storm, Level 1 treatment).
Significant Impacts		Pollution during and after storms of the streams near and in urban areas. Significant DO drops during and following storms. Recreational use of the streams is downgraded.	Removal of portions of the stormwater pollutants: BOD - 40%, SS - 70%, coliforms and bacteria, and many other harmful constituents. Meeting of State water quality standards.
Plan Evaluation			
1. Contributions to Planning Objectives		None	Provides reduction in stormwater runoff so that State water quality standards can be met. (Level 1 treatment of stormwater.)
2. Relationship to Four National Accounts			
a. NED ($ million)	3, 5, 7, 9		
(1) Beneficial Impacts		-	5.0
(2) Adverse Impacts		-	107.8
(3) Net Impact		-	-102.8

Footnotes indexed at the end of this table

Table G-22
(Cont'd)
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes[1/]	Do-Nothing	Upstream Storage and Treatment
b. EQ			
(1) Pollutant Loadings Attributable to Stormwater (1995) (tons/year)	2, 5, 8, 9		
(a) BOD		3,060	1,840
(b) SS		25,070	7,520
(2) Minimum DO Concentrations (mg/l)	1, 5, 8, 9		
(a) Little Papillion		3	6
(b) Big Papillion and Papillion		0	6
(3) Land required for Stormwater Treatment Facilities (acres)		0	2,271
(4) Construction Disruption	1, 6, 8, 9	No	Yes - for storage basin and interceptor construction.
(5) Fish and Wildlife	2, 5, 8, 9	Only pollution tolerant species	Greater diversity of species present.
c. SWB			
(1) Recreation	2, 5, 8, 9	Little use of the area waters for recreational purposes.	Improved water quality of area waters should encourage more water-related recreation.
(2) Consumer Costs (cost/customer-month)	2, 5, 7, 9	0	$.73
d. RD ($ million)			
(1) Local Cost	3, 5, 7, 9	0	20.5
(2) State Cost	1, 5, 7, 9	0	11.4 Nebraska .4 Iowa
(3) Federal Cost	1, 5, 7, 9	0	75.5

1/ Footnotes indexes at the end of this table

Table G-22
(Cont'd)
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes[1/]	Do-Nothing	Upstream Storage and Treatment
3. Plan Response to Associated Evaluation Criteria			
a. Effectiveness		No	Yes - can go to a higher level of treatment if necessary for an additional 31.3 million dollars.
b. Certainty		-	PL 92-50 requires stormwater treatment by 1983. Economics may be a problem and this requirement may be relaxed (See Federal Register, Vol. 40, No. 103, May 28, 1975.)
D. Implementation Responsibilities			
1. Initiation of Plan		-	Municipalities in which the stormwater treatment system is to be constructed.
2. Funding of the Plan			
a. Capital		-	Nebraska / Iowa Local 12.5% / 20% State 12.5% / 5% Federal 75% / 75%
b. O&M		-	Local (Municipalities)
3. Funding Capabilities		-	Federal and State funding is not keeping up with the needs. Local funding - See paragraphs 167 through 171.

Footnotes indexed on next page

Index of Footnotes

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation).

Uncertainty

4. The uncertainty associated with the impact is 50 percent or more.
5. The uncertainty is between 10 percent and 50 percent.
6. The uncertainty is less than 10 percent.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

130. The main impact of the upsystem treatment alternative is the removal of a significant portion of the pollutants in the storm runoff. Forty percent of the BOD and 70 percent of the suspended solids would be removed. Chlorination would remove almost all of the fecal coliforms in the flow, thereby reducing the health hazard potential of the stormwater runoff. The removals of these three constituents should result in area stream quality that meets the State Water Quality Standards of Nebraska and Iowa.

131. The NED impacts given in table G-22 are mainly the adverse impacts since it is hard to put a monetary value on the beneficial impacts, mainly improved water quality. The beneficial impact shown represents the value of unemployed labor used to construct the facilities. The value presented is 5 percent of the capital cost of the alternative. The adverse impact is the present worth cost to implement the plan until 2020. Since upsystem storage and treatment is the only alternative left that meets the planning objectives, it is the NED plan.

132. Modeling of the Little and Big Papillion Creeks to show the effects of stormwater and its treatment on water quality indicates significant impacts on the dissolved oxygen concentrations of the streams. The DO would improve from 3 mg/l to 6 mg/l on the Little Papillion Creek and from zero to 6 mg/l on the Big Papillion and Papillion Creeks with Level 1 stormwater treatment. This improvement should result in a greater diversity of wildlife associated with the streams.

133. Implementation of the upsystem storage and treatment alternative would have an adverse impact on the environment in that disruption of the land in close proximity to area streams would occur for construction of the required facilities.

134. The EQ plan is upsystem storage and treatment. The alternative presented in table G-22 calls for Level 1 treatment, but the EQ plan would be upsystem storage and treatment to Level 2 criteria for stormwater.

135. The improvement of the water quality in the area streams would improve the quality of flood plain recreation in the study area. The cost to remove the stormwater pollutants is estimated to be $.73 per month per customer.

136. The costs to implement the urban stormwater treatment plan would be incurred by the local municipalities, the States of Iowa and Nebraska, and the Federal government. As with the other wastewater plans, in Nebraska the capital costs would be shared 12.5 percent, 12.5 percent, and 75 percent by the local, State, and Federal agencies, respectively. In Iowa, the costs are 20 percent local, 5 percent State, and 75 percent Federal. All O&M costs would be paid for by the local municipalities.

137. Many people may feel that stormwater treatment is too costly and should not be done. PL 92-500 requires that stormwater treatment be accomplished to comply with 1983 requirements of the Act. This requirement appears to be economically infeasible and changes in the requirements of PL 92-500 are being examined (See <u>Federal Register</u>, Vol. 40, No. 103, May 28, 1975).

STRUCTURAL VERSUS NON-STRUCTURAL

138. As pointed out in Section F of this report, there are some non-structural alternatives which would reduce the amount of urban runoff pollution. The following paragraphs contain a brief comparison of the structural and non-structural alternative solutions for reducing stormwater pollution.

139. More efficient street sweeping can lower the amount of stormwater pollutants that originate from streets (see Annex D of the Supporting Technical Reports Appendix). The city of Omaha currently follows about a 45-day sweeping frequency. By increasing the frequency to 12 days the city can reduce the street pollutant load an additional 30 percent. Since street pollutants comprise 20 percent of the overall urban stormwater pollution, a 12-day street-sweeping frequency could reduce this source of pollution by 6 percent.

140. By routing impervious area runoff over a pervious area equivalent in size to the impervious area, storm runoff pollution from the impervious area can be reduced by 73 percent for low-frequency storms (see Annex D, Supporting Technical Reports Appendix). Assuming that 80 percent of the pollutants comes from the impervious areas (other than streets) during the low-frequency storms, storm runoff pollution could be reduced 58 percent. This figure would decrease until it reached zero for a major design storm event.

141. Based on the above analysis, stormwater pollution could be reduced by 64 percent (58 plus 6). This compares to 40 percent BOD reduction and 70 percent suspended solids removal with Level 1 stormwater treatment.

142. The non-structural alternatives appear to be very effective for the low-frequency storm events. The comparison may not be very good for a one-year storm event and most likely becomes even worse for the higher frequency storm events. This should not deter city officials and developers from implementing these non-structural alternatives since they can be effective in reducing the amount of urban stormwater pollutants.

EVALUATION OF WET-WEATHER FLOW TREATMENT

143. The control and abatement of pollution from combined sewer overflows and separate urban storm runoff are as yet only roughly defined. The EPA discusses these special cases in its "Water Strategy Paper", Second Edition, February, 1974. The following points developed in that strategy paper are relevant to the Omaha-Council Bluffs area:

> Unlike secondary treatment for treatment plants, there is not a generally recognized acceptable level of treatment for overflows and stormwater discharges.
>
> Overflows and storm sewers will not be considered publicly-owned treatment works for the purpose of complying with the effluent standards of secondary treatment for 1977 nor will a separate uniform effluent standard be promulgated for them. Correction of overflow problems will be defined in terms of meeting the applicable water quality standards of 1977 and the fishable/swimmable standards of 1983. "Meeting water quality standards" is itself a concept which will be further defined in guidance by EPA.
>
> An additional consideration in examining the need for correction of wet-weather flows results from correlating the water use to be protected (as an example, swimming) with the season and frequency that rainfall occurs. If swimming activities only occur during a season when there is little or no rainfall, correction of wet-weather flows may be unwarranted.

144. In light of the above EPA strategies, the wastewater management study has considered a range of storm events and treatment

levels for wet-weather flows. Storm events ranged from 1 to 10 years; treatment levels ranged from 40 percent BOD and 70 percent suspended solids removals to near "zero discharge". The effects of do-nothing and the alternatives were modeled using dissolved oxygen as the modeled parameter. Based on the modeling, the 1-year design storm was selected for all urban wet-weather flows. Treatment levels were provided to maintain stream-dissolved oxygen according to existing State standards.

145. The limitations of the stormwater analysis must be stated. Limitations are apparent in three areas; pollutant load, modeling, and ecological effects.

146. The stormwater analysis used primarily simulated data from the studies applied to specific land uses. The pollutant load values used did not differentiate between old and new urban areas. Analysis of the street sweepings indicates a significant differential between old and new urban areas pollutant loads; the newer urban areas exhibited much lower loads than the older areas.

147. Modeling used in the study does not account for other types of organic and inorganic pollutants in the wet weather flows. Modeling for most of these other pollutants is not possible.

148. The DOSAG model, which was used for the modeling, is the static type which analyzes a slug of water as it passes through the stream. The dissolved oxygen at any particular time is based on a combination of oxygen-consuming materials, rate of deoxygenation of those materials, and natural reaeration of the stream. Under storm conditions and "shock loads", none of the above may act in a static fashion.

149. Defining true ecological impacts for intermitent "shock loads" is currently impossible. Most small streams in the urban area are physically incapable of supporting diverse aquatic life. Urban pollutants entering the Missouri River are not readily dispersed but maintain a pollutant flume for several miles downstream. It is currently not possible to determine whether this lack of dispersion minimizes or maximizes ecological impacts.

150. While the above limitations and uncertainties are evident, several valid conclusions can be made from the wet-weather flow analysis. These conclusions are discussed below.

- Treatment of combined sewer overflows and urban storm runoff is required to maintain State water quality standards.

- Retention of the 1-year storm coupled with treatment will maintain water quality standards for dissolved oxygen.

- It is more cost-effective to increase treatment levels rather than storage capacity. Relatively slight increases in pollutant removal results in considerable dollars spent when the storage capacity is sized for larger than the 1-year storm event.

- Retention of the 1-year storm will enable capture of the "first flush" of all storms.

- Treatment of stormwater near the source provides flexibility, for incorporating non-structural measures and results in more cost effective solutions.

Cost Effectiveness Comparisons

151. The following paragraphs contain a discussion of the cost effectiveness of wastewater treatment and stormwater treatment. The comparison will be based upon total pollutant reduction on an annual basis. A comparison of the present-worth costs required to achieve various reductions in pollutant parameters as influenced by the various treatment levels of wastewater and stormwater will be presented.

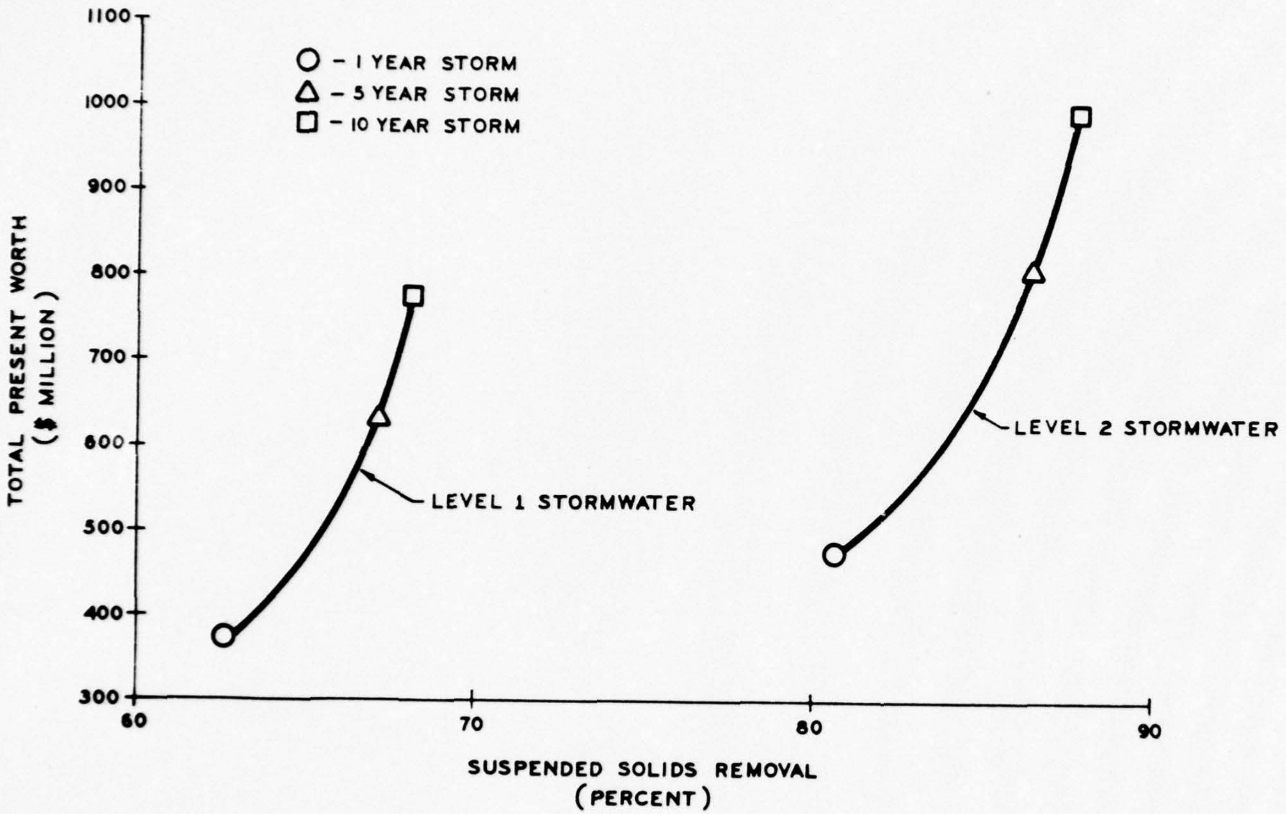
152. The figures presented with this discussion were developed from Plan I of the initial plans using Growth Concept A costs. Annual pollutant reductions for 1995 were also used.

153. The suspended solids curve, figure G-2, illustrates that in order to achieve substantial reduction, stormwater treatment must be employed. Levels of wastewater treatment have negligible effects.

154. The BOD curve, figure G-3, illustrates that the variation in reduction is relatively small (90.6 percent to 96.9 percent), for the increased levels of wastewater and stormwater treatment.

155. The phosphorus curve, figure G-4, shows significant reduction from Level 1 to Level 2 wastewater. Stormwater reductions are negligible for phosphorus.

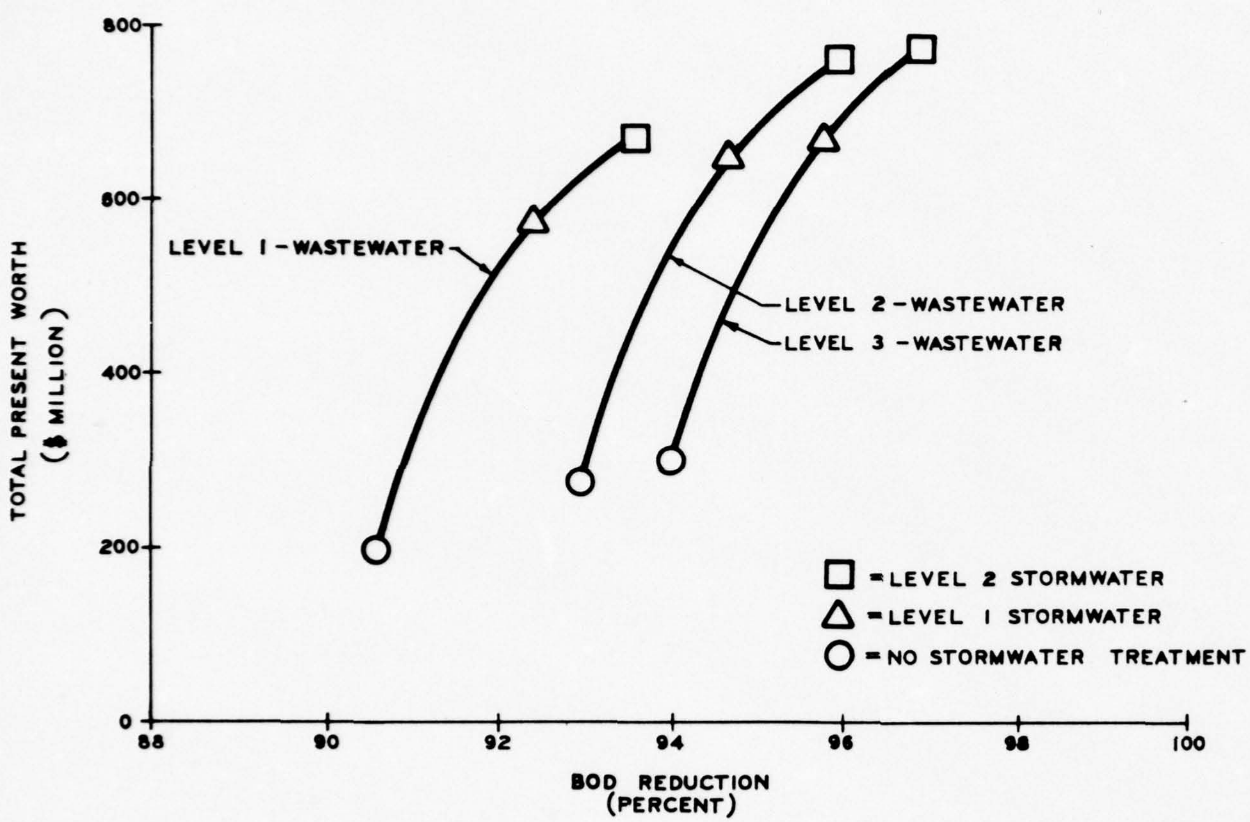
156. The nitrogen curve, figure G-5, shows significant reduction from Level 2 to Level 3 wastewater. The curve is misleading due



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

COST EFFECTIVESS

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975



METROPOLITAN OMAHA, NEBRASKA
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COST EFFECTIVENESS

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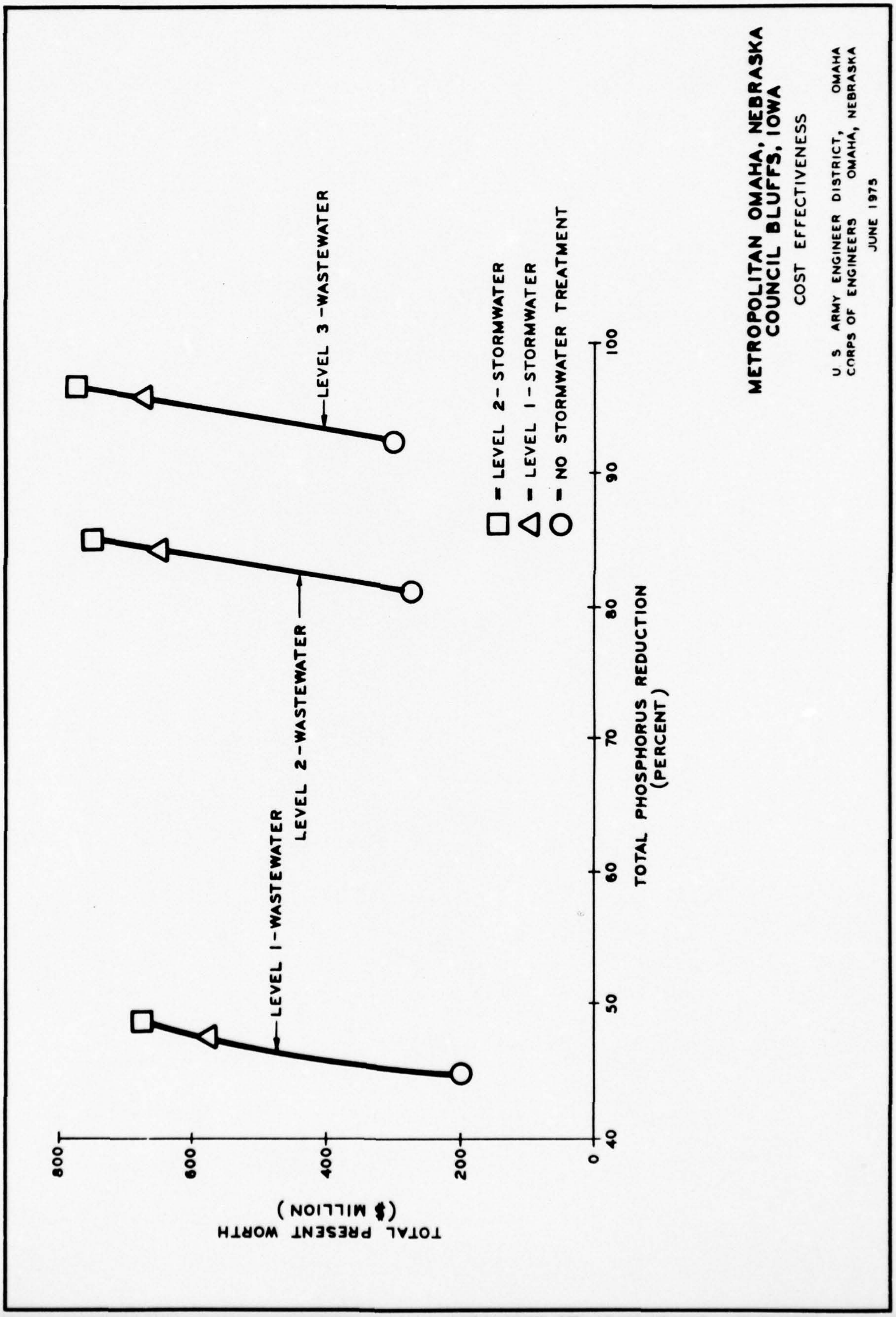
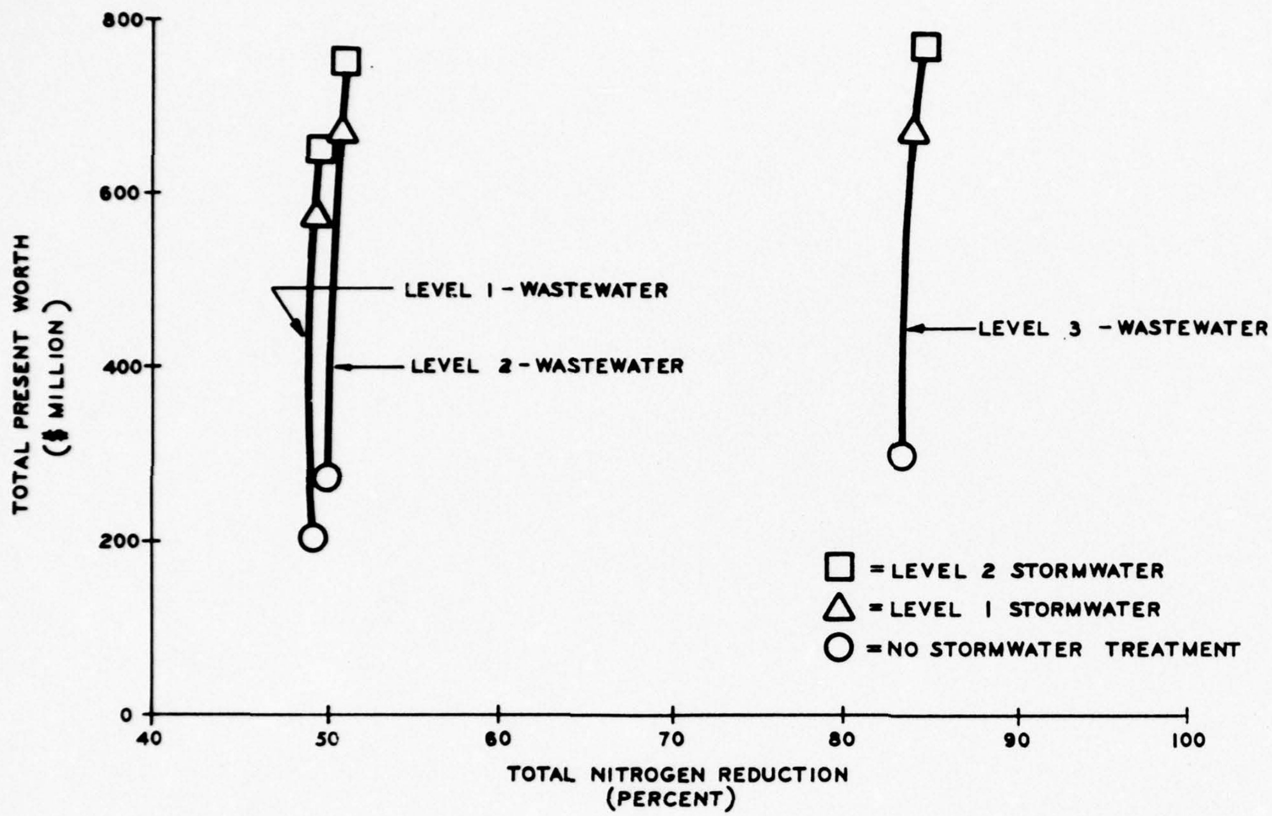


VOLUME III ANNEX B FIGURE G-4



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VOLUME III ANNEX B FIGURE G-5

to the fact that Level 2 wastewater does provide nitrification which is not given any credit in the curve.

157. The overall pollutant reduction curve, figure G-6, applies equal weight to each of the four parameters mentioned. It shows that treatment of wastewater to higher levels is more cost effective than stormwater treatment. A problem with this presentation is that there are other pollutants (bacteria, gross solids, etc.) associated with urban runoff, separate and combined, which are not accounted for in this cost effective analysis.

158. The curves indicate that, with the exception of suspended solids, the pollutant parameters are more effectively reduced by upgrading wastewater effluents than by stormwater treatment. This generalization applies only to the total annual inputs and could be somewhat misleading especially with no treatment of stormwater. In an individual storm situation some treatment for floating material and bacterial contamination appears desirable.

Reliability of Wastewater Management Plans

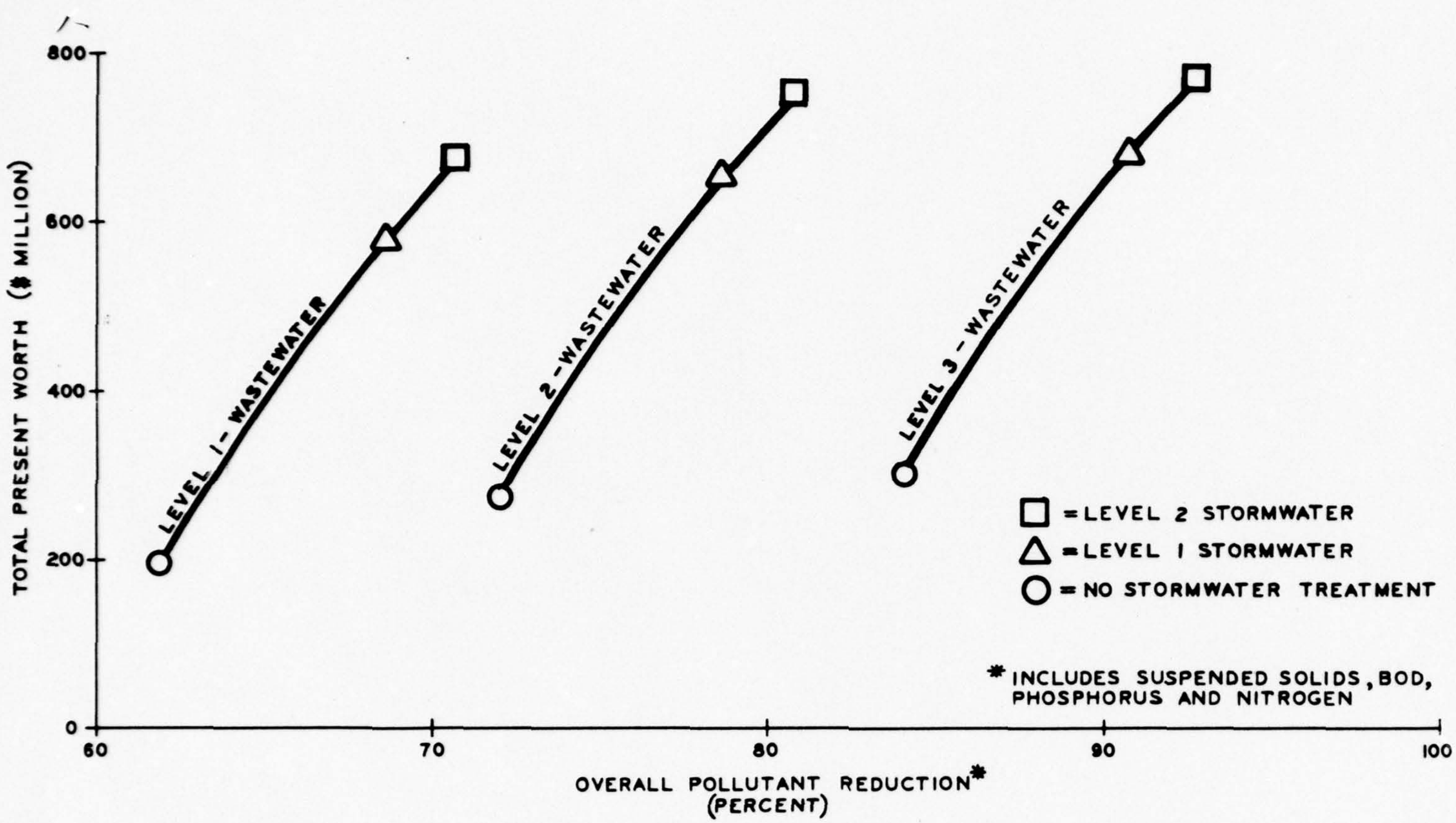
EFFECTS OF REGIONALIZATION

159. Presently, there are approximately 100 sewage treatment plants located in the seven-county study area. The wastewater management plans call for reducing the number of plants to less than 50. This consolidation should provide a treatment system that is more reliable than the system presently in existence.

160. Many small, independent treatment plants do not have the capability to provide good treatment. Even if the equipment is capable of providing the required level of treatment, the personnel hired to operate the equipment are not presently qualified to provide adequate operation. There are approximately 36 individual plants that are in the proposed Papillion Creek system in Plan 2 of the wastewater management plans. Only four of these plants meet the secondary (Level 1) treatment standards for BOD and suspended solids. Many are overloaded, but poor operation accounts for many of the problems.

161. Regionalization of the treatment plants, as proposed in the wastewater management plans, has several advantages which should make the system more reliable. Among these are:

- Higher quality top management and operators can be hired due to consolidation of jobs and ability to pay higher salaries.



METROPOLITAN OMAHA, NEBRASKA
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- The larger an individual system is, the more finances it has to handle all problems.

- The larger treatment plants have multiple facilities which can carry the load of a unit shutdown for repair or routine maintenance.

- A larger plant can dilute shock loads more readily.

- It is easier to monitor and control several large plants than many small plants.

162. Too much regionalization can also create problems. Some examples are:

- One major point-source does not use the assimilative capacity of a stream as well as many small sources of wastewater.

- There are more places where raw sewage may be discharged due to trunk-sewer, pump-station, or interceptor failure.

163. The above advantages and disadvantages were considered in arriving at the final wastewater management plans. For instance, the Missouri River plant was retained since two point-sources would create a lower impact on the Missouri River than one larger point-source. Implementation of any one of the final wastewater management plans would result in a wastewater treatment system more reliable than the one in existence.

EFFECTS OF TREATMENT LEVELS

164. As additional treatment levels are required, the reliability of the treatment systems, as far as the removal of pollutants is concerned, would increase. If a unit were to fail in the primary or secondary portion of the system, tertiary units would protect the waters discharged into by removing much of the pollutants normally removed by the malfunctioning unit. For example, in the major urban plants, activated sludge treatment is used in the Level 2 treatment system to convert the organic and ammonia nitrogen to nitrites and nitrates. These same units would also reduce the BOD load not removed by the Level 1 units in the system.

EFFECTS OF LAND TREATMENT

165. The land treatment alternatives would have an effect on the reliability of overall wastewater treatment. As with increased treatment levels, the land treatment system acts as a backup to the treatment plants. If the treatment plant were to malfunction, the land treatment system would remove the additional pollutants. Land treatment systems have been used to treat wastes of higher strength than secondary effluent at much higher hydraulic loads than proposed in this study, and have functioned properly. The land treatment systems proposed in this report could also provide a small amount of emergency treatment at the storage lagoon locations. These lagoons would act to dilute any shock load not removed during the secondary treatment process.

166. The reliability of treatment may also be adversely affected by land treatment. Pumping or pipeline failure could result in the discharge of Level 1 effluents to local streams. Also, an

unusually wet year or growing season could mean that land treatment sites would be incapable of handling all of the treated effluents from the plants and that the effluents would have to be discharged to the local streams without higher levels of treatment.

Financial Feasibility of Wastewater Mangement

167. The feasibility, from an economic standpoint, of implementing the wastewater management plans presented in this report will be discussed in the following paragraphs.

168. Revenue bonds would most likely be issued to finance the capital improvements presented in this study. These bonds would be paid off by sewer fees which are paid each month by the customers served. In order to put the costs of the projects in perspective, an estimated average cost per customer per month was calculated. These costs were determined for the year 1995 and reflect, to a certain extent, the average increase in the monthly sewer fee that area residents pay. This fee is presently about $4 per customer per month.

169. Table G-23 presents the summary of the estimated costs per customer per month for each of the wastewater plans presented in this study for the city of Omaha. The important figure is the total cost of the projects. The costs for Level 1 treatment range from \$3.89 to \$5.14 per customer per month. The costs for Level 2 treatment is approximately \$1.00 per month higher. Level 3 costs are not presented since the environmental scan does not appear to warrant such treatment. Level 1 treatment of stormwater, combined and separate, appears to be all that is required to meet water quality standards at this time for dissolved oxygen.

170. The overall cost of the wastewater management plans does not appear to put too much of a financial burden on the average customer in the Omaha area. The monthly sewer fee would need to be more than doubled in order to cover the costs, but the new sewer fee would only be about one percent of the average customer's income.

171. It must be emphasized that the costs presented are based on Federal and State cost sharing. If the present cost-sharing breakdown, 12.5; 12.5; and 75 in Nebraska or 20; 5; and 75 in Iowa, is altered, the local cost changes would alter the monthly estimated costs presented in table G-23. Presently, it appears that the 1983 requirements of PL 92-500 cannot be met, mainly because of the financial burden the Federal government will have to bear. Proposed amendments to PL 92-500 appear in the Federal Register (Vol. 40, No. 103, May 28, 1975). These proposals reflect the concern of officials over the economic burden that PL 92-500 has placed on the Federal government. Depending on the nature of any changes ma made in PL 92-500, the financial arrangements and feasibility of implementing the wastewater management plans presented in this report could be altered.

Table G-23
Omaha Wastewater Management Costs
($ per customer month)

	Level 1	Level 2	Level 3
Wastewater Treatment	1.88 to 1.93	2.85 to 4.26	3.31 to 4.26
Omaha-Missouri River Combination Sewer	1.04 to 2.12	1.04 to 2.12	-
Omaha-Papillion Creek Combination Sewer	.24 to .36	.24 to .36	-
Stormwater	.73	.73	-
Total	3.89 to 5.14	4.86 to 6.20	-

Agricultural Stormwater Pollutants

172. Agricultural pollutants were discussed very briefly in Section E of this report. The present methods for reducing the pollutant loads to the area waters were outlined. The following paragraphs provide information on the effect of these pollution control methods on the agricultural stormwater pollution load.

173. Certain farming practices would reduce the amount of cropland runoff and pollution. An example has been cited in the Nebraska River Basin Water Quality Management Plans. The report states that sediment yield, and in turn pollution, was reduced by more than 95 percent by crop rotation and terraces. Annual stormwater loads were computed by the wastewater management consultant for 1975, 2020,

and several years in between. These figures indicate that implementation of proper farming practices would reduce the four main pollutants, suspended solids, BOD, phosphorous, and nitrogen, by 84 percent by 1985 and 90 percent by 2020.

174. The same Basin Water Quality Management Plans state that effluent from feedlot runoff is not recommended for later discharge into any stream. The plans recommend land disposal as the disposal solution. Havens and Emerson, wastewater management consultants, indicate that compliance with this recommendation would result in zero pollution from feedlots by 1980.

175. Reduction of pollution from croplands and feedlots would have a major effect on rural stormwater pollutant loads by 2020. There are other sources of rural stormwater pollution in addition to previously discussed sources. The wastewater management consultant predicts that by 2020, the overall reduction of rural stormwater pollutants would be from 86 to 91 percent, depending on the pollutant.

Growth Concepts

176. Throughout the wastewater management planning process, four growth concepts for the Omaha-Council Bluffs urban area have been used to estimate pollutant loads, collection system arrangements, and facility sizing as well as many other components of the wastewater system. Costs have also been computed for each plan using the four alternative growth patterns as a variable.

177. In theory, certain of the growth patterns can be encouraged by each of the wastewater management plans. Plan 1 encourages urban sprawl as depicted in Growth Concepts A and D while Plans 2, 3, and 3 Option, as presented in this report, encourage constrained growth in the metropolitan area, Growth Concepts B and C. Even though the wastewater system encourages a certain growth pattern, many other factors such as the water supply system and transportation (streets mainly) system, also influence the ultimate pattern for urban growth. Due to this, all four growth concepts were used in analyzing each of the wastewater management plans.

178. Table G-24 was developed to show the effect of the growth concepts on the physical features of the wastewater management plans. Even though the total design capacities add up to the same total capacity, the required capacities at individual facilities vary considerably. For example, the design capacity of the Papillion Creek plant to meet 2020 loadings ranges from 73.4 to 98.0 MGD. The number and sizing of the stormwater facilities also varies with the growth concepts.

179. The effects on capacity utilization of wastewater treatment facilities can be significant. For example, the Omaha-Missouri River plant is currently under design with secondary facilities sized at 65 MGD. Growth Concept C makes better use of this capacity. Growth Concepts A and D will create additional facility expansion to the Papillion Creek plant. The same analysis also applies to interceptor sewers.

180. The variances in the physical features also influence the costs of the plans presented in this report. The effects of the

Table G-24
Wastewater Management Physical Features

	Plan A 1995	Plan A 2020	Plan B 1995	Plan B 2020	Plan C 1995	Plan C 2020	Plan D 1995	Plan D 2020
Wastewater Treatment Plant Capacities (MGD)								
Omaha-Missouri River	47.0	60.4	43.3	60.2	51.3	67.5	48.4	60.3
Omaha-Papillion Creek	61.2	98.0	45.2	73.4	56.8	90.7	60.7	97.8
Council Bluffs-Mosquito Creek	16.4	29.9	14.7	26.6	16.5	29.9	15.6	30.1
Minor Urban (total)	9.08	11.31	30.37	39.23	9.14	11.38	8.88	11.28
Non-Urban (total)	2.807	3.224	2.807	3.224	2.807	3.224	2.807	3.224
Land Treatment Option								
Major Urban (acre-ft/yr)	69,193	131,914	61,321	109,747	69,524	130,240	71,347	129,778
Minor Urban (acre-ft/yr)	6,650	12,425	18,097	41,873	6,650	11,271	6,650	12,760
Non-Urban (acre-ft/yr)	3,142	3,610	3,142	3,610	3,142	3,610	3,142	3,610
Major Interceptor Length Required (feet)		392,000		330,000		330,000		392,000
Papillion Creek Combined Sewer								
Storage Volume (acre-ft)	479	479	489	489	487	487	469	469
Treatment Capacity (MG/yr)	2,133	2,248	2,027	2,124	1,972	1,972	2,027	2,124
Number of New Stormwater Treatment Facilities	14	35	15	32	15	32	14	36
Stormwater Retention Volumes (acre-ft)	4,667	8,329	4,436	6,121	3,999	5,735	5,155	8,345

growth concepts on Plan 1 costs are depicted in table G-25. The cost to implement a given level of treatment can vary by about 5 percent, depending on the growth concept.

Table G-25
Wastewater Management Plan 1 Present Worth Costs
($1,000,000)

Level and Type of Treatment	Growth Concept A	B	C	D
1 Wastewater	195.4	206.0	193.0	185.5
1 Stormwater	107.8	111.6	104.2	115.9
1 Combined Stormwater	193.8	194.9	194.6	192.3
Total	497.0	512.5	491.8	493.7
2 Wastewater	277.4	292.4	274.9	275.5
1 Stormwater	107.8	111.6	104.2	115.9
1 Combined Stormwater	193.8	194.9	194.6	192.3
Total	579.0	598.9	573.7	583.7

181. Economic evaluation of the wastewater management plans and growth concepts has emphasized that the future growth of the metropolitan area can influence the cost of implementing wastewater and stormwater treatment in the Omaha-Council Bluffs urban area. In general, Growth Concept C is the most economical growth pattern to follow as far as wastewater management is concerned.

SECTION H

INSTITUTIONAL ARRANGEMENTS FOR WASTEWATER MANAGEMENT

INSTITUTIONAL ARRANGEMENTS FOR WASTEWATER MANAGEMENT

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SECTION H

INSTITUTIONAL ARRANGEMENTS FOR WASTEWATER MANAGEMENT

Purpose

1. This section has two purposes: (1) to present the legal, organizational, financial, and political arrangements required to implement water quality alternatives; and (2) to present institutional and technical requirements for comprehensive wastewater management planning and implementation.

Introduction

2. The development of institutional arrangements represents one of the final steps in the urban study planning process. It is the step that outlines the procedures necessary to convert a plan into an action program.

3. This section lists alternative implementation strategies for the wastewater management plans. Legal arrangements include requirements for new laws, changes in existing laws, and interagency agreements. Organizational arrangements include requirements for new agencies and changes in missions of existing agencies. Financial arrangements identify the requirements for new funding and the agencies to accomplish it. Political arrangements include political problems and obstacles that must be overcome to implement the alternative plans.

4. In regard to comprehensive, areawide wastewater management planning, this section compares the requirements of Sections 201 and 208 of PL 92-500 with the comprehensive wastewater management planning achievements of the Metropolitan Area Planning Agency (MAPA) and the Corps of Engineers, and it explains the remaining requirements to complete 208 planning for the metropolitan area.

Institutional Arrangements for Management

5. Four alternative arrangements are proposed for the management of wastewater treatment facilities in the study area: (1) one agency for the entire area; (2) two agencies, one in Nebraska and one in Iowa; (3) multiple agencies with consolidation of services where practicable; and (4) multiple agencies with little consolidation. In all four alternatives, it is assumed that

planning for facilities and land use controls is included in an adopted areawide comprehensive plan. Other sections of this annex propose alternative solutions to the combined sewer overflow problems in the Missouri River and Little Papillion Creek watersheds in Omaha and to the combined sewer problems in Council Bluffs. The choice among alternatives is not affected by the management arrangement adopted.

ALTERNATIVE MANAGEMENT ARRANGEMENT "A"

6. This arrangement envisions one agency to design, construct, operate, and maintain all, or any portion of, the treatment facilities and the local portion of land treatment facilities in the seven-county area.

LEGAL CONSIDERATIONS

7. This arrangement requires new legal agreements and legislative action in both States.

8. The proposed agency could operate in all areas as a separate political subdivision or under contract to the separate jurisdictions. If the agency operated as a separate political subdivision, this alternative requires the establishment of intergovernmental agreements signed by all counties, by the Nebraska natural resources districts, and by all municipalities in the study area. As a separate political subdivision, the agency would have limited powers of taxation, the power of eminent domain, and the power to operate independently. It is believed that establishment of an organization with these powers would require legislative action in both States. Operating under contract, the agency would be subject to local agreements concerning land

acquisition, financing, rate controls, and expansion of service. Both States have laws which permit the necessary agreements: Article 22, Nebraska Revised Statutes (Interlocal Cooperation Act); and Chapter 28E, Iowa Code (Joint Exercise of Governmental Powers).

9. Land irrigation proposals in Plan 3 and Plan 3 Option require the proposed agency to overcome current legal prohibitions against transbasin diversion of surface water in Nebraska. The diversions proposed in either plan do not appear to be detrimental to the losing basins because there is no present nor planned reuse of the effluents once they are discharged into the receiving waters. In the areas where the effluents are to be spread on the land, there does not appear to be any significant legal problems to overcome other than guarantees that the quality of the effluent is not harmful to crops or animals. An environmental assessment would be required.

ORGANIZATIONAL CONSIDERATIONS

10. The agency could be organized as a metropolitan sanitary district with an elected board of directors representing subdistricts in both States, a general manager and staff, and an operation and maintenance organization. It is also possible that this organization could be a department of the existing Metropolitan Utilities District, provided that Iowa residents participated in the election of the board members. A change may be required to elect board members by precincts or subdistricts rather than by the current at-large system.

FINANCIAL CONSIDERATIONS

11. Because of the high cost of facilities, it is assumed that all major construction in the study area would require Federal

grants under Section 201, PL 92-500. Section 201 requires that grantees construct revenue-producing facilities. The local share of the cost of construction should be reimbursed by the revenue from the system rather than from general purpose taxes or general obligation bond funds. This section does not present the amount of funds to be raised by revenue bonds. The cost to the individual for sewer use is displayed in another section of this annex. Generally, the overhead costs for management arrangement "A" would be less than for other alternatives. For land irrigation aspects of Plan 3 and Plan 3 Option, the financing of the transmission facilities must be proven cost effective in order to obtain Federal assistance. Otherwise, agreements would be required between the losing agency and the gaining agency concerning funding of the facilities.

POLITICAL CONSIDERATIONS

12. The consensus of officials interviewed indicated that there are major political obstacles to the creation of a single wastewater management agency with authority in both States. The opinions were not officially stated and were made without the benefit of a complete institutional analysis. It is possible that a thorough examination of the overhead savings, the organizational structure, and the legal authority may change many current opinions. South Sioux City, Nebraska wastewater treatment is accomplished by the Sioux City, Iowa treatment plant. Land application of wastewater treatment effluents is a new concept for Nebraska and Iowa and would probably result in a political conflict unless full assurances are provided that the effluents to be applied to the land would not be detrimental to the environment.

ALTERNATIVE MANAGEMENT ARRANGEMENT "B"

13. This arrangement envisions two management agencies, one in Nebraska and one in Iowa. As with arrangement "A", the two agencies would construct, operate, and maintain all, or any portion of, the treatment facilities and the local portion of land treatment facilities in their respective areas.

LEGAL CONSIDERATIONS

14. The proposed agencies could operate in all areas as separate political subdivisions or under contract to the separate jurisdictions. Operating as separate political subdivisions, the agencies would require legal agreements with all participating jurisdictions. As separate political subdivisions, the agencies would have limited power of taxation, the power of eminent domain, and the power to operate independently. The establishment of agencies with these powers is possible within existing statutes or with minor modifications thereto. Operating under contract, the agencies would be subject to the terms of contracts with each participating subdivision concerning land acquisition, financing, and expansion of service. As with arrangement "A", both States have laws authorizing interlocal agreements. Legal arrangements for land irrigation are identical to arrangement "A".

ORGANIZATIONAL CONSIDERATIONS

15. The organization of the proposed agency in Nebraska is identical to arrangement "A". In Iowa, the agency could be established as a sanitary district, as described in paragraph 381 of Section B, Volume VIII, (Institutional Arrangements). The chapter of the Iowa Code pertaining to sanitary districts probably did not envision a three-county district; however, the provisions of the code do not prohibit such arrangements.

FINANCIAL CONSIDERATIONS

16. The financial considerations for this arrangement are identical to those for management arrangements "A".

POLITICAL CONSIDERATIONS

17. It is believed that there may be some political opposition in Washington and Cass Counties to the expansion of wastewater management agencies to those areas. It is possible that opposition could disappear if signifcant economies could be realized by regional management. Support in these two counties would probably be dependent upon assurances of efficient management and of equitable cost-sharing. Political obstacles to land irrigation are identical to those presented in arrangement "A".

ALTERNATIVE MANAGEMENT ARRANGEMENT "C"

18. This arrangement envisions multiple management agencies in the study area, continues current arrangements, and consolidates management in the rural areas. Under this arrangement, the city of Omaha manages the Papillion Creek plant and the Omaha-Missouri River plant; the city of Council Bluffs manages the Mosquito Creek plant; and other cities, sanitary and improvement districts, and rural residents form consolidated wastewater management systems to the extent practicable. Many rural areas would still rely on individual septic tanks or small treatment lagoons.

LEGAL CONSIDERATIONS

19. The significant legal considerations in this arrangement are the authorities necessary for the city of Omaha to accept, for treatment, wastewater from political subdivisions and industries outside Omaha's corporate limits; and the authorities required

for consolidated management agencies to treat wastes or manage facilities on an areawide basis in rural areas. There do not appear to be any State legislative changes necessary to implement this arrangement.

20. At the present time, the city of Omaha is proceeding with plans to construct, operate, and maintain the Papillion Creek Treatment Plant. The city of Omaha has contractual agreements to accept for treatment, wastewater from the cities of Bellevue, Papillion, Carter Lake, and Ralston; from Offutt Air Force Base; from National By-Products, Incorporated; and from two sanitary and improvement districts in Sarpy County. The contracts indicate that these entities have given to the city of Omaha the authority to control the financial, qualitative, and quantitative aspects of wastewater management and that they have agreed to comply with any changes that may become necessary as a result of new Federal or State regulations. The contracts make the city of Omaha a regional wastewater management agency.

21. In order for smaller communities, sanitary and improvement districts, rural industries, and rural residents to meet the 1983 goal, it may be necessary to consolidate wastewater treatment on an areawide basis by watersheds. Many sanitary and improvement districts (SID's) in the Nebraska counties of the study area have treatment facilities that are not capable of meeting effluent standards or are not operated by trained personnel. Many of the small incorporated communities also have inadequate facilities. To obtain Federal and State funding to upgrade their facilities, the SID's and small communities would be required to consider consolidation of treatment or management of treatment facilities, or both, with other communities, SID's, or industries. One way

to achieve improved treatment in the Nebraska counties would be to establish basinwide treatment management under the auspices of the natural resources districts (NRD's). This method, discussed further under organizational considerations, would require legal agreements between the separate wastewater dischargers and the NRD's. In Iowa, the same arrangement would be established with a sanitary district assuming the role of areawide management.

ORGANIZATIONAL CONSIDERATIONS

22. The city of Omaha has the requisite organizational capability to manage the Papillion Creek plant and any other plants within its jurisdiction. Council Bluffs has the organizational capability to manage the Mosquito Creek plant and any planned expansions of the plant. The Nebraska natural resources districts have the organizational framework to establish wastewater management activities; however, additional staffing may be required to carry out their portion of this management arrangement. In Iowa, additional sanitary districts would have to be organized in the study area.

FINANCIAL CONSIDERATIONS

23. The construction costs for treatment works are currently financed under a formula wherein the Federal Government pays 75 percent and the local applicant pays 25 percent. The States may pay all or a portion of the local share. The State of Nebraska pays 12.5 percent and the State of Iowa pays 5 percent of the local share. Under this management arrangement, the local share would be provided by the cities of Omaha and Council Bluffs and other communities, by the natural resources districts in Nebraska, or by the county sanitary districts in Iowa. The normal method of raising the local share of funds is through the issuance of long term revenue bonds repaid from service charges to the customers

of the wastewater management agency. Applications for State and Federal funding assistance in the study area are submitted to the Governor of each State. Member governments of the Metropolitan Area Planning Agency must also submit applications through the executive director of MAPA for review and comment.

POLITICAL CONSIDERATIONS

24. The political problems in this management arrangement are those which may arise (1) between the city of Omaha and the officials of the jurisdictions which rely upon the Omaha system for waste treatment; and (2) between rural communities and natural resources districts or sanitary districts.

25. As management agencies enforce the terms of the contracts pertaining to connection charges, user fees, quantity and quality of discharge, and future expansion, there may be conflicts. The agencies would be responsible for complying with Federal and State regulations on treatment plant discharge quality. A case could arise where one or more of the major political jurisdictions or industrial dischargers do not comply with Federal or State regulations. The agency could find it politically difficult to resolve such violations unless legal agreements were ironclad.

ALTERNATIVE MANAGEMENT ARRANGEMENT "D"

26. This arrangement envisions multiple management agencies in the study area and differs from management arrangement "C" in that there would be little or no consolidation of wastewater management services outside the Council Bluffs or Omaha-Papillion Creek systems. Treatment works would be constructed by the individual communities,

sanitary and improvement districts, and industries. There would be little or no participation by regional agencies such as Nebraska natural resources districts or county sanitary districts in Iowa.

LEGAL CONSIDERATIONS

27. There would not be any legislative action required to implement this management arrangement. The significant legal consideration is whether this arrangement would result in wastewater management that would comply with Federal and State requirements. The thrust of PL 92-500 is regionalized management that realizes maximum economies of scale.

ORGANIZATIONAL CONSIDERATIONS

28. All agencies concerned with wastewater management have, or would be able to achieve, the organizational capability to implement this arrangement.

FINANCIAL CONSIDERATIONS

29. The financial considerations are similar to those in management arrangement "C" except that the local share of construction costs would be borne by the individual communities, SID's, or industries.

POLITICAL CONSIDERATIONS

30. The political considerations in this arrangement are the same as in the previous management arrangements for the Omaha system. For the areas outside Omaha and Council Bluffs, there are few consolidations of wastewater services so there would be the minimum number of political problems.

FEASIBILITY OF ALTERNATIVE MANAGEMENT ARRANGEMENTS

31. The four alternative management arrangements just presented are all feasible and each arrangement is capable of implementing plans to solve wastewater management problems in the study area.

32. Management arrangement "A" places maximum emphasis on regionalization and economies in staff personnel. The probability that this arrangement would be adopted is diminished because it would require major changes in organization to combine the management of treatment plants in both States.

33. Management arrangement "B" has a high degree of emphasis on regionalization and economies in staff personnel. It would require legislative action in both States to permit regional management of wastewater treatment in the rural areas.

34. Management arrangement "C" has some emphasis on regionalization in that it calls for consolidation of services. It would take advantage of existing institutions and require little organizational change in these institutions. It would require a great deal of coordination among the smaller communities and the special purpose districts in both States.

35. Management arrangement "D" has little emphasis on regionalization. There would be little requirement for coordination of efforts which diminishes political opposition to this arrangement. The significant considerations in this arrangement are that it would create a large number of small treatment facilities requiring trained operators, and it would increase requirements for effluent monitoring equipment and personnel.

Wastewater Planning and Management

36. This subsection describes the two alternative procedures available to decision makers for solving wastewater planning and management problems. The alternatives are: (1) comprehensive, areawide waste treatment management planning under Section 208 of the Federal Water Pollution Control Act Amendments of 1972; or (2) facilities planning under Section 201 of the Act.

SECTION 208 PLANNING

37. Areawide waste treatment management planning is designed to attain water quality goals of the Federal Water Pollution Control Act Amendments of 1972. A primary goal of the Act is to achieve by 1983 a level of water quality that will support aquatic life and recreation in and on the Nation's waters. Areawide planning and management efforts under Section 208 of the Act will focus on sources of pollution that threaten achievement of this 1983 goal.

PROGRAM APPLICABILITY

38. Areawide planning and management for designated areas are intended to address, in an integrated manner, difficult urban/industrial point-source pollution problems, severe nonpoint-source pollution problems, and associated management problems of an area. Such planning and management are to be used within designated areas where base level technological solutions to pollution problems cannot achieve water quality goals, or where such solutions fail to be the most cost-effective solutions to the problems. The technological remedies referred to here are wastewater treatment plants

and related facilities. The Act makes other provisions; e.g., Facilities Planning under Section 201, for localities where these kinds of remedies are sufficient to solve pollution problems.

39. In determining whether areawide planning and management mechanisms are appropriate for an area in order to address water quality problems and achieve the above 1983 goal of the Act, decision makers should consider the following questions:

- Does the area have difficult urban/industrial pollution problems? (point-source problem)

- Does the area have severe pollution problems emanating from diffuse sources; e.g., agricultural runoff? (nonpoint-source problem)

- Has the population growth of the area been above the national average?

- Does the area have a severe ground water problem resulting from pollution generated in the area?

40. If an area has any or all of the problems listed above, consideration should be given to the following questions:

- Do current plans and proposals address each relevant problem?

- Are there institutional constraints prohibiting effective solutions to the problems?

• Can each municipality acting alone solve the pollution problems?

41. If decision makers conclude that their area has these problems and lacks effective solutions through existing or proposed programs, then an areawide planning and management approach should be considered. Section 208 of the Act provides the planning funds and the mechanisms for this approach.

PROGRAM FEATURES

42. In September 1973, the United States Environmental Protection Agency (EPA) published Planning Area and Agency Designation Regulations in the Federal Register (40 CFR Part 126). These regulations set forth criteria which planning areas and agencies would have to satisfy to be eligible for a 208 designation. In May of 1973, the EPA published Interim 208 Grant Regulations (40 CFR Part 35, Subpart F) which establish procedures for the preparation and approval of grant applications, and which describe required plan contents and the process of plan submittal and review. Also in May of 1973, the EPA distributed Draft Guidelines for Areawide Waste Treatment Management Planning. The guidelines are for use by planning agencies and other organizations involved in the 208 planning process.

DESIGNATION FACTORS

43. Pursuant to the Act and the Planning Area and Agency Designation Regulations, Section 208 areas and agencies are to be designated by the Governor of a state or, in some instances, by elected officials of the area. In interstate areas, the Governor has three options: he may choose, after consultation with local

officials, to designate, nondesignate, or remain silent. EPA has encouraged Governors to either designate or nondesignate. If he chooses to remain silent in regard to an area, local elected officials of the area may designate their area and seek approval directly from EPA. Although there is no appeal from nondesignation by a Governor, nondesignation does not preclude later designation of the area by the Governor. After appropriate local consultation local officials can seek designation approval as part of the interstate planning area.

44. In order to be designated, an area must meet the criteria specified in the Area and Agency Designation Regulations. In keeping with these regulations, a preference will be given to areas of urban/industrial concentration with substantial water quality problems. This preference, however, does not preclude non-urban/industrial areas from being designated under the Act. If an area is non-urban but has a substantial water quality problem that could best be addressed by a local agency, the area can be designated. A substantial water quality problem, in this regard, would be such that a large percentage of stream segments in the area are "water quality limited" and there are many point and nonpoint sources of pollution within the area. Alternatively, if the area is not an urban/industrial concentration, but is one in which high quality waters exist and are threatened by development, the area can also be designated as a Section 208 area. But, provision for nondegradation of the waters in the area must explicitly and without qualification be included in the State's water standards, and such nondegradation of the area's water must be adopted as the 208 planning goal. Both Nebraska and Iowa have nondegradation statements in their water quality standards.

45. In addition to the above criteria, local governments within the 208 planning area must either have in operation a coordinated waste treatment system or show their intent (through adopted resolutions of agreement) to join together in the 208 planning process. Their joint effort must result in a water quality management plan for a coordinated waste treatment management system for the area.

WATER QUALITY MANAGEMENT PLAN

46. The Act and Interim Grant Regulations prescribe that designated planning agencies are to develop a water quality management plan for: (1) municipal and industrial point-source waste systems including storm and combined sewer discharges; (2) pollution emanating from diffuse sources; (3) protection of ground water; and (4) pollution resulting from disposal of residual wastes. The plan is to be cost-effective (minimum resource, social, and environmental cost) and implementable. The plan must consider nonstructural techniques for control and abatement of pollution, including control of the use of land where applicable. The planning horizon for these plans is 20 years; however, plans must be dynamic and capable of meeting near-term goals and objectives as well.

PLANNING PROCESS FRAMEWORK

47. The Draft Guidelines for Areawide Waste Treatment Management Planning describe a planning process which may be used in preparing areawide water quality management plans. The planning process used by planning agencies should be designed to enable the systematic examination of a variety of technical and management alternatives for accomplishing water quality goals.

48. The basic planning features of the planning process described in the guidelines are: identification of problems and constraints; development and analysis of plans to solve the problems; selection of a plan; and annual updating of the plan.

PLAN CONTENTS

49. The required contents of areawide water quality management plans as set forth in the grant regulations and planning guidelines include the following.

- Identification of anticipated municipal and industrial treatment works construction over a 20-year period.

- Planning for facilities eligible under 40 CFR 35.917-1 (a)-(i) and 40 CFR 35.1062 and for which Step 2 or Step 3 grant assistance is expected during the 5-year period following 208 plan approval.

- Identification of required urban stormwater runoff control systems.

- Establishment of construction priorities over 5-year and 20-year periods.

Establishment of a regulatory program to: (1) provide for waste treatment management on an areawide basis and for identification, evaluation, and control or treatment of all point- and non-point-pollution sources; (2) regulate the location, modification, and construction of waste-discharging facilities; and (3) assure that industrial or commercial wastes discharged into publicly owned treatment works meet applicable pretreatment requirements.

• Identification of agencies necessary to construct, operate, and maintain facilities required by the plan and otherwise carry out the plan.

• Identification of nonpoint sources of pollution including those related to agriculture, silviculture, mining, construction, and certain forms of salt water intrusion; and identification of procedures and methods (including land use provisions) to control those sources to the extent feasible.

• Processes to control the disposition of residual waste and land disposal of pollutants to protect ground and surface water quality.

• Selection of a management system and necessary agencies to implement the plan and identification of the major management alternatives (including enforcement, financing, land use, and other regulatory measures and associated management authorities and practices).

• A schedule for implementing all elements of the plan, including identification of the costs of implementation.

• Required certifications relating to consistency with other plans and to public participation in the planning process and plan adoption.

• Recommendations of appropriate local governing bodies as to State certification and EPA approval of the plan.

FINANCIAL ASSISTANCE

50. Financial assistance is provided to designated planning agencies for a period of up to 24 months to develop an initial plan for the area. For obligations made during FY 1974 and FY 1975, the Federal share will be 100 percent of the eligible costs of the project. After FY 1975, the Federal share will be 75 percent.

51. Plan Submittal. After review and approval by the Governors of the States, areawide planning agencies are to submit the initial plan to the Environmental Protection Agency within 24 months after award of a planning grant. At the time of plan submission, one or more areawide waste treatment management agencies must be designated to implement the plan and to receive Federal construction grants under Title II of the Federal Water Pollution Control Act Amendments of 1972.

52. Cordination With Other Planning Activities. Areawide waste treatment management planning is to be coordinated with other provisions of the Act, such as facilities planning, basin planning permits, and State environmental program provisions. Areawide planning and management activities are also to be coordinated with other planning programs in the area that impact upon or that are impacted by water quality. Of particular interest are air, solid waste, water supply, and other resource management programs of the area.

53. Public Participation. Given the scope and detail of areawide waste treatment management planning, an active program of public participation is to be initiated in each designated area to encourage citizens to participate in such activities as the following:

- Designation of planning areas and agencies;

- Development of the areawide planning process;

- Defining goals;

- Establishing priorities;

- Understanding land use - water quality relationships; and

- Selection and implementation of the final areawide waste treatment management plan.

54. The views of community residents regarding areawide planning and management issues will be of critical importance in formulating alternative technical and management plans and in implementing any selected plan.

FACILITIES PLANNING UNDER SECTION 201

55. The alternative to comprehensive areawide planning under Section 208 is facilities planning under Section 201 of the Federal Water Pollution Control Act Amendments of 1972. Basically, Section 201 provides for Federal funding assistance to achieve the goals of PL 92-500 in areas that do not require comprehensive, areawide planning for waste treatment management.

PROGRAM APPLICABILITY

56. Section 201 states that the following requirements must be met by applicants in order to secure Federal funding assistance:

• The applicant must agree to develop and implement waste treatment management plans and practices that will achieve the goals of the act;

• Management plans and practices must provide for the best practicable waste treatment technology to include consideration of advance treatment techniques;

• Waste treatment management plans must be areawide to the extent practicable;

• Applicants must consider construction of revenue-producing facilities providing for: recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products; the confined and contained disposal of pollutants not recycled; the reclamation of wastewater; and the ultimate disposal of sludge in a manner that will not result in environmental hazards;

• The applicant must agree: (1) to pay the local share of construction costs; (2) to assure efficient operation and maintenance; and (3) to employ trained management and operations personnel;

• The size and capacity of treatment facilities relate directly to the needs of the area to be served;

• The applicant must adopt a system of charges to assure that each recipient of services pays a proportionate share of costs;

• Industrial users must repay the construction costs attributable to their needs;

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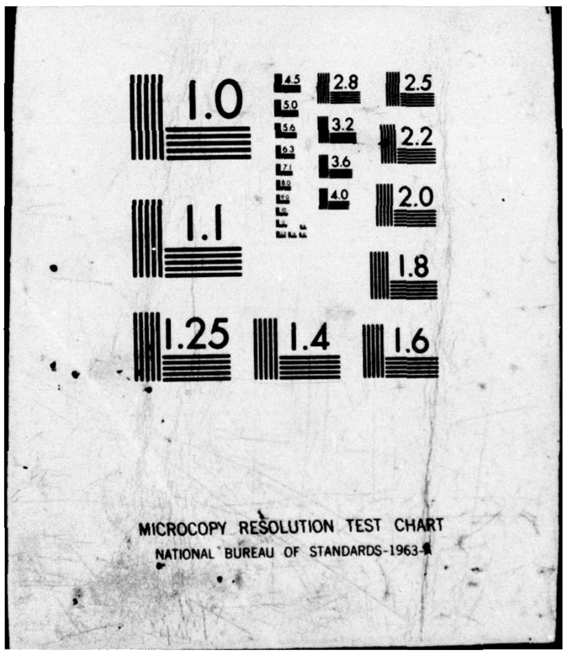
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• Applicants must consider integrating municipal and industrial waste treatment; and

• Applicants must consider combining "open space" and recreation considerations with treatment management.

57. Before choosing this method to solve wastewater management problems, decision makers must determine that: (1) areawide management can be accomplished by the municipalities working alone; (2) institutional problems either do not exist or can be overcome; and (3) current planning considers and provides for the treatment of all point and nonpoint sources of pollution.

CONDITIONS AND LIMITATIONS ON SECTION 201 GRANTS

58. Among other things, the condition significant to the study area is that the applicant must have legal, institutional, managerial, and financial capability to insure adequate construction, operation, and maintenance of treatment works within the applicant's jurisdiction.

PLANNING AGENCIES

SECTION 208 PLANNING

59. According to PL 92-500, the agency designated to conduct comprehensive areawide planning must be a representative organization consisting of elected officials from local governments or their designees; these designees must be capable of developing effective areawide waste treatment management plans. The Metropolitan Area Planning Agency appears to be the only agency in the study area that meets the above conditions.

SECTION 201 PLANNING

60. PL 92-500 emphasizes areawide waste treatment management. It appears that any municipality in the study area could develop areawide treatment management plans for a limited area. Omaha is becoming an areawide waste treatment manager for the southern portion of Papillion Creek basin because the city has comprehensive contractual agreements with other jurisdictions. The agreements are limited to urban/industrial point sources of pollution. Council Bluffs and the remaining cities in the study area control waste treatment within their corporate limits and, in some cases for areas adjacent to their corporate boundaries.

Future Planning

PRESENT STATUS OF PLANNING

61. At this time there is one approved plan for wastewater management in the study area, the MAPA 1972 Comprehensive Water Pollution Control Plan. This plan was developed and approved prior to the enactment of the Federal Water Pollution Control Act Amendments of 1972. The plan covers facilities necessary to treat urban/industrial wastes for Douglas and Sarpy Counties in Nebraska, and for Pottawattamie County and a portion of Harrison County in Iowa. The MAPA plan identifies present and future needs, presents alternative technical plans, identifies nonpoint sources of pollution, and establishes a basis for further planning. Since adoption

of the MAPA plan in 1972, Council Bluffs has constructed its primary and secondary treatment plant; Omaha has started construction on its Papillion Creek primary and secondary plant and has completed design for the upgrading of the Missouri River plant; and Bellevue has requested a Federal grant to upgrade one of its two plants to secondary treatment.

62. The Corps of Engineers Urban Study addresses combined sewer overflows, urban and agricultural runoffs, land treatment of urban wastewater, land use-water quality, and institutional arrangements for the study area.

ALTERNATIVE PLANNING STRATEGIES

63. Planning for wastewater management can be accomplished with or without Federal funding assistance. If Federal funds are requested, planning can be done in two ways -- comprehensive areawide planning under Section 208 of PL 92-500, or facilities planning under Section 201.

SECTION 208 PLANNING

64. As indicated in PL 92-500, comprehensive areawide planning should be undertaken in those areas with difficult pollution-control problems and where significant management problems are evident. This study has shown that these criteria apply to the Omaha-Council Bluffs area.

65. The officials of the separate governments and the citizens of this area should consider the important requirements of PL 92-500 discussed in paragraph 49 of this section before electing to pursue a program of comprehensive areawide planning under Section 208.

66. The governmental officials and citizens in the proposed study area must agree, prior to requesting 208 designation, that they are committed to preparing, implementing, and enforcing any plan developed by the approved planning agency and adopted by their elected officials.

SECTION 201 FACILITIES PLANNING

67. As indicated in PL 92-500, the facilities planning approach to wastewater management should be undertaken in those areas where incremental planning is appropriate. This kind of planning is applicable to areas where municipalities, working alone, can solve wastewater management problems.

68. It is possible that the Omaha-Council Bluffs area can solve its problems with this approach. It appears more practical to study all the various water pollution problems at one time. In this way a complete priority list of capital improvements can be developed.

Summary

69. This section has presented four alternative management arrangements to accomplish wastewater management in the study area, and it has summarized the significant points to be considered before embarking upon a comprehensive, areawide wastewater management planning program.

70. The following significant institutional considerations were surfaced in this section.

- The metropolitan Omaha-Council Bluffs area can benefit from comprehensive, areawide wastewater management planning.

- The Metropolitan Area Planning Agency has the appropriate legal, organizational, and political authority to conduct areawide planning.

- The consolidation of wastewater management services in the outlying areas is feasible and practical.

- The organizations exist to implement the above consolidations.

- A continuation of present management trends may not obtain cost-effective solutions to areawide problems.